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TEST REPORT  
FOR  
PRESSURE REGULATOR

Johnson Service Company Part Number R-970

NASA Drawing Numbers 75MO4406 PPR-5

and

75MO4406 PPR-6

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SPACE DIVISION



CHRYSLER  
CORPORATION

TEST REPORT

FOR

PRESSURE REGULATOR

Johnson Service Company Part Number R-970

NASA Drawing Number 75MO4406 PPR-5

and

75MO4406 PPR-6

ABSTRACT

This report presents the results of tests performed on one sample of the Pressure Regulator 75MO4406 PPR-5 and 75MO4406 PPR-6. The following tests were performed:

- |                         |                        |
|-------------------------|------------------------|
| 1. Receiving Inspection | 5. Vibration Test      |
| 2. Proof Pressure       | 6. Operational Cycling |
| 3. Functional           | 7. Burst               |
| 4. Surge                |                        |

The specimen performance was in accordance with the specification requirements of NASA drawings 75MO4406 PPR-5 and 75MO4406 PPR-6 throughout the test program. It was noted, however, that the specimen dial settings shifted during the vibration and operational cycling tests and that the specimen pressure setting adjustment was very coarse and difficult to set.

The pressure regulator structurally withstood all of the test environments.

## FOREWORD

The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS8-4016, Part VII, CWO 271620.

TEST REPORT

FOR

PRESSURE REGULATOR

Johnson Service Company Part Number R-970

NASA Drawing Number 75MO4406 PPR-5

and

75MO4406 PPR-6

February 17, 1967

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

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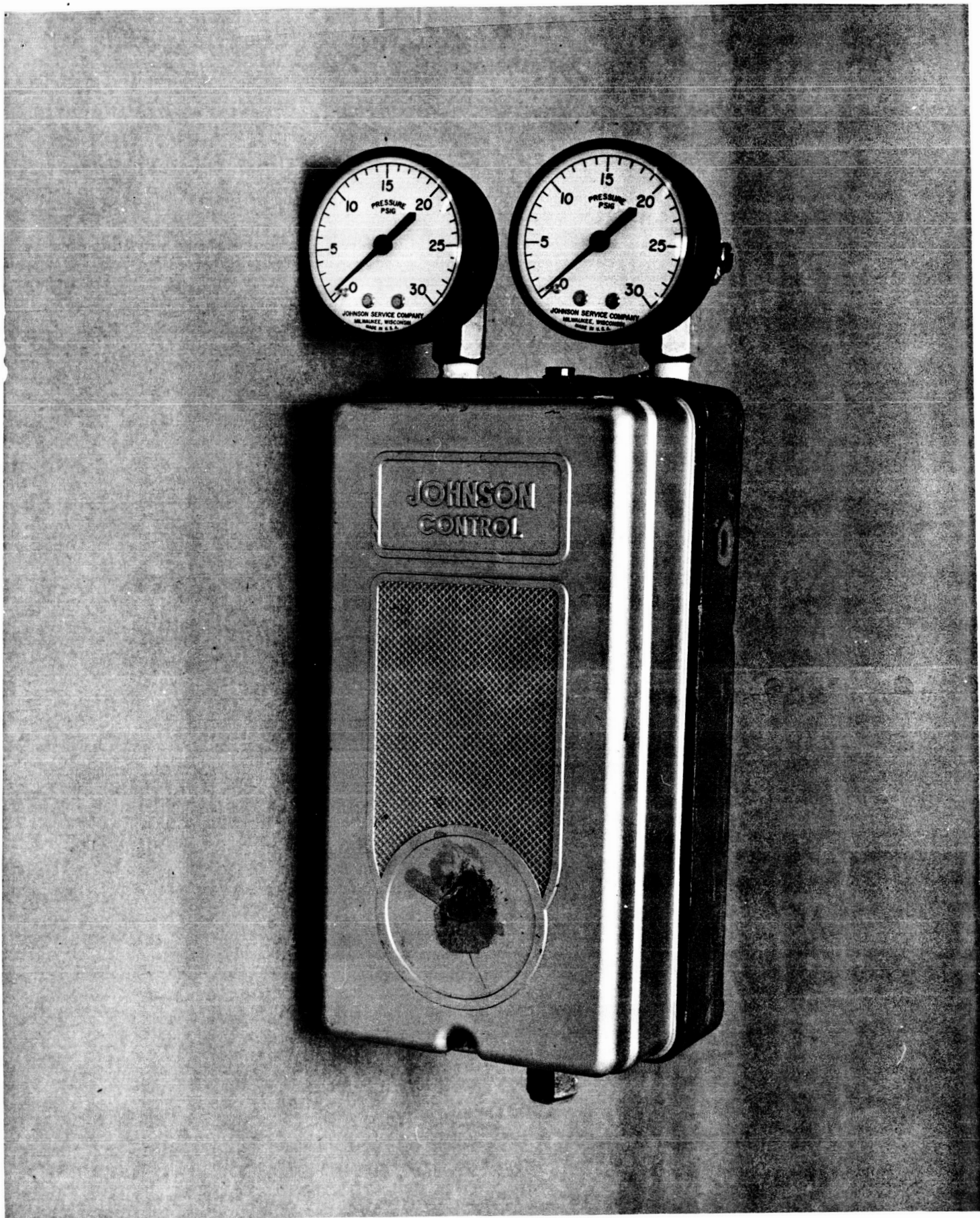
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Pressure Regulator 75M04406 PPR-5 and 75M04406 PPR-6  
vii

# CHECK SHEET

FOR

## PRESSURE REGULATOR

MANUFACTURER: Johnson Service Company

MANUFACTURER'S PART NUMBER: R-970

NASA PART NUMBERS: 75MO4406 PPR-5 and 75MO4406 PPR-6

TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana

AUTHORIZED AGENCY: NASA KSC

### I. FUNCTIONAL REQUIREMENTS

- |                         |                                                                          |
|-------------------------|--------------------------------------------------------------------------|
| A. OPERATING MEDIUM:    | Dry air or Nitrogen                                                      |
| B. OPERATING PRESSURE:  | 0 to 20 psig                                                             |
| C. PRESSURE REGULATION: | Direct or reverse acting                                                 |
| D. LEAKAGE:             | Zero external leakage                                                    |
| E. PROOF PRESSURE:      | 30 psig                                                                  |
| F. BURST PRESSURE:      | 80 psig                                                                  |
| G. SENSITIVITY:         | The sensitivity proportional ratio shall be adjustable from 1:10 to 4:1. |

### II. CONSTRUCTION

- |                   |                             |
|-------------------|-----------------------------|
| A. BODY MATERIAL: | Brass                       |
| B. SEAL MATERIAL: | Unknown                     |
| C. LENGTH:        | Unknown                     |
| D. INLET PORT:    | 1/8-inch female pipe thread |

### III. ENVIRONMENTAL CHARACTERISTICS - MANUFACTURER'S SPECIFICATIONS

- |                           |                |
|---------------------------|----------------|
| A. OPERATING TEMPERATURE: | None specified |
|---------------------------|----------------|

### IV. LOCATION AND USE:

The pressure regulator will be used in the environmental control system at Launch Complex 34 to provide control pressure to the compressor unloader valve and the refrigerant expansion valves located in the "A" conditioning units.

# TEST SUMMARY

## PRESSURE REGULATOR

75M04406-PPR-5 and 75M04406-PPR-6

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Receiving Inspection	1	Drawings and specifications	Conformance with drawings and specifications	Satisfactory	Inspection completed
Proof Pressure Test	1	30 psig	Check for leakage and distortion	Satisfactory	No leakage or distortion
Functional	1	20 psig supply pressure 0 to 20 psig sensing pressure	Check control pressure at various sensing pressures and sensitivities	Satisfactory	Test completed
Surge	1	0 to 20 psig within 100 milliseconds 25 cycles	Determine if specimen operation is impaired by surge	Satisfactory	Test completed
Vibration	1	10g peak sinusoidal 0.20g <sup>2</sup> /cps random	Determine if specimen operation is impaired by vibration	Satisfactory	Test completed
Operational Cycle	1	1 to 20 to 1 psig 5000 cycles	Determine if specimen operation is impaired by operational cycling	Satisfactory	Test completed
Burst	1	80 psig	Check for leakage and distortion	Marginal	Lower diaphragm assembly leakage

## SECTION I

### INTRODUCTION

#### 1.1 SCOPE

This report presents the results of tests performed to determine if Pressure Regulator 75MO4406 PPR-5 and 75MO4406 PPR-6 satisfies the operational and environmental requirements for John F. Kennedy Space Center Launch Complex 34. A summary of test results is presented on page ix.

#### 1.2 ITEM DESCRIPTION

1.2.1 The pressure regulator is manufactured by Johnson Service Company as model R-970. The regulator provided control pressure temperature regulation in the environmental control system.

1.2.2 The specimen has three ports; i.e., supply, sensing, and control pressure. The sensing pressure is provided by a similar regulator (model T-900) which senses temperature and converts it to a pressure signal. The regulator (R-970) then converts the pressure signal to a control pressure, at a predetermined ratio, to operate the large control valves that regulate the cooling media.

1.2.3 The regulator operates on a GN<sub>2</sub> supply pressure of 20 psig and senses pressure in the range of zero to 20 psig. It converts a sensing-port pneumatic pressure to a control-port pneumatic pressure in any ratio between 1:10 to 4:1. The regulator can also be set for a reverse sensing/control pressure ratio. It then converts an increasing sensing pressure to a decreasing control pressure.

1.2.4 Configurations 75MO4406 PPR-5 and 75MO4406 PPR-6 differ only in that 75MO4406 PPR-5 is a direct-acting regulator and 75MO4406 PPR-6 is a reverse-acting regulator. Either configuration can be converted to the other by a simple adjustment. Two 0-to 30 psig gages are mounted on the regulator and indicate supply and control pressure.

#### 1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for pressure regulator 75MO4406 PPR-5 and 75MO4406 PPR-6.

- a. KSC-STD-164(D), dated September 17, 1964, Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy.
- b. NASA Drawing 75MO4406 PPR-5, Component Specification
- c. NASA Drawing 75MO4406 PPR-6, Component Specification

d. Cleaning Standard MSFC-STD-164(D)

e. Test Plan CCSD-FO-1069-1F

## SECTION II

### RECEIVING INSPECTION

#### 2.1 TEST REQUIREMENTS

The specimen shall be visually and dimensionally inspected for conformance with the applicable specifications prior to testing.

#### 2.2 TEST PROCEDURE

A visual and dimensional inspection of the specimen was performed to determine compliance with NASA drawings 75MO4406 PPR-5, 75MO4406 PPR-6, and the applicable vendor drawing to the extent possible without disassembly of the test specimen. At the same time the test specimen was also inspected for poor workmanship and manufacturing defects. The equipment listed in table 2-1 was used in performing the inspection.

#### 2.3 TEST RESULTS

The specimen complied with NASA drawings 75MO4406 PPR-5 and 75MO4406 PPR-6. No evidence of poor workmanship or manufacturing defects was observed.

#### 2.4 TEST DATA

The data presented in tables 2-2 and 2-3 were recorded during the inspection.

Table 2-1. Receiving Inspection Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Micrometer	Craftsman	9-4090	NASA 106-1137 -P	0.001-inch graduation
2	Illuminated Magnifying Glass	Dazor	F-209	NA.	

Table 2-2. Specimen Nomenclature

Name	Johnson Service Company Pressure Regulator
Manufacturer's Part Number	R-970
NASA Part Numbers:	75MO4406 PPR-5 and 75MO4406 PPR-6
Serial Number	None

Table 2-3. Specimen Dimensions

Dimension	Maximum Allowable Measurement	Actual Measurement
Overall Length	10-1/8	10-1/16
Overall Width	4-7/8	4-3/4
Overall Depth	3-1/8	2-15/16
Body Length	7-5/8	7-5/8
Body Width	4-1/16	4-1/16

## SECTION III

### PROOF PRESSURE TEST

#### 3.1 TEST REQUIREMENTS

- 3.1.1 The sensing port of the test specimen shall be pressurized to 30 psig with GN<sub>2</sub> for 5 minutes.
- 3.1.2 The supply and control ports of the specimen shall be pressurized to 30 psig with GN<sub>2</sub> for 5 minutes. The leak port shall be plugged.
- 3.1.3 The test specimen shall be checked for leakage and distortion during and after the proof pressure test.

#### 3.2 TEST PROCEDURE

- 3.2.1 The test specimen was installed in the test setup shown in figure 3-1 and 3-2 using the equipment listed in table 3-1.
- 3.2.2 All hand valves were closed, and flex hose 17 was attached to the sensing port of specimen 20.
- 3.2.3 Hand valves 1 and 9 were opened. Regulator 4 was adjusted to provide 50 psig as indicated on gage 5. Regulator 6 was adjusted to provide 30 psig as indicated on gage 7. The 30 psig proof pressure was maintained at the sensing port of the specimen for 5 minutes.
- 3.2.4 Regulator 6 was adjusted for zero outlet pressure, hand valve 11 was opened to vent the specimen, and flex hose 17 was disconnected from the specimen.
- 3.2.5 Hand valve 11 was closed and hand valve 10 was opened. Flex hose 18 was connected to the supply port of the specimen and flex hose 17 was connected to the control port of the specimen.
- 3.2.6 Regulator 6 was adjusted to provide 30 psig as indicated on gage 7. The 30 psig proof pressure was maintained at the supply and control ports of the specimen for 5 minutes.
- 3.2.7 Hand valve 1 was closed and hand valve 11 was opened to vent the system.
- 3.2.8 Test data were recorded.

#### 3.3 TEST RESULTS

No leakage was detected and there was no evidence of structural damage.

#### 3.4 TEST DATA

Test data shown in table 3-2 were recorded during the proof pressure test.

Table 3-1. General Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Hand Valve	Combination Pump and Valve Company	380-4	NA	1- $\frac{1}{2}$ -inch
2	Filter	Bendix	1731261	NA	2-micron
3	Pressure Gage	Ashcroft	NA	NASA 200616-K	0-to 5000-psig 0.1% FS accuracy Calibration date 8/6/66
4	Pressure Regulator	Tescom	26-1003	1001	0-3000-psig outlet
5	Pressure Gage	Heise	NA	NASA 200613-2	0-to 100-psig 0.1% FS accuracy Calibration date 7/9/66
6	Pressure Regulator	Whitey	316	22RF4	0-to 100-psig precision type
7	Pressure Gage	Heise	NA	NASA 108-1002 -B	0-to 60-psig 0.1% FS accuracy Calibration date 8/13/66
8	Hand Valve	Robbins	SS-NG250 -4T	NA	1/4-inch
9	Hand Valve	Robbins	SS-NG250 -4T	NA	1/4-inch
10	Hand Valve	Robbins	SS-NG250 -4T	NA	1/4-inch
11	Hand Valve	Robbins	SS-NG250 -4T	NA	1/4-inch
12	Pressure Regulator	Watts	119-3	NA	0-to 100-psig precision type
13	Pressure Gage	Heise	NA	NASA 95-1376 -B	0-to 60-psig +0.1% FS accuracy Calibration date 8/6/66

Table 3-1. General Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
14	Pressure Gage	Heise	NA	NASA 108-1002 -B	0 to 60-psig +0.1% FS accuracy Calibration date 8/13/66
15	Hand Valve	Robbins	SS-NG250 -4T	NA	1/4-inch
16	Flex Hose	Resistoflex	NA	NA	1/4-inch
17	Flex Hose	Resistoflex	NA	NA	1/4-inch
18	Flex Hose	Resistoflex	NA	NA	1/4-inch
19	Flex Hose	Resistoflex	NA	NA	1/4-inch
20	Test Specimen	Johnson Service Company	R-970	NA	Pressure regulator 0-to 20-psig
21	GN <sub>2</sub> Supply	CCSD	NA	NA	3500-psig
22*	Accumulator	Parker	NA	NA	2/3-cubic foot
23**	Solenoid Valve	Marotta	MV-74	NA	1/4-inch, 3-way, normally open
24**	Timer	G. C. Wilson and Company	No. 1	NA	
25**	Power Supply	Sorensen	QR36-4A	NASA 015447	28-vdc Calibration date 10/27/66
26**	Counter	Durant	NA	NA	5-digit
27*	Pressure Transducer	Consolidated Electrodynamics	4-350- 0001	S/N 2443	0-to 100-psig +0.5% FS accuracy Calibration date 11/8/66

\* Required only for surge test.

\*\* Required only for surge and life cycle tests.

Table 3-1. General Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
28*	Oscillograph Recorder	Consolidated Electrodynamics	5-124	NASA 017887	Calibration date 9/20/66
29***	Hand Valve	Robbins	SSKA250-4T	NA	1/4-inch
30***	Pressure Gage	Heise	NA	NASA 014229	0-to 30-psig ±0.25% FS accuracy Calibration date 11/3/66
31	Relief Valve	Anderson Greenwood	81B66-6	23665	75-psig

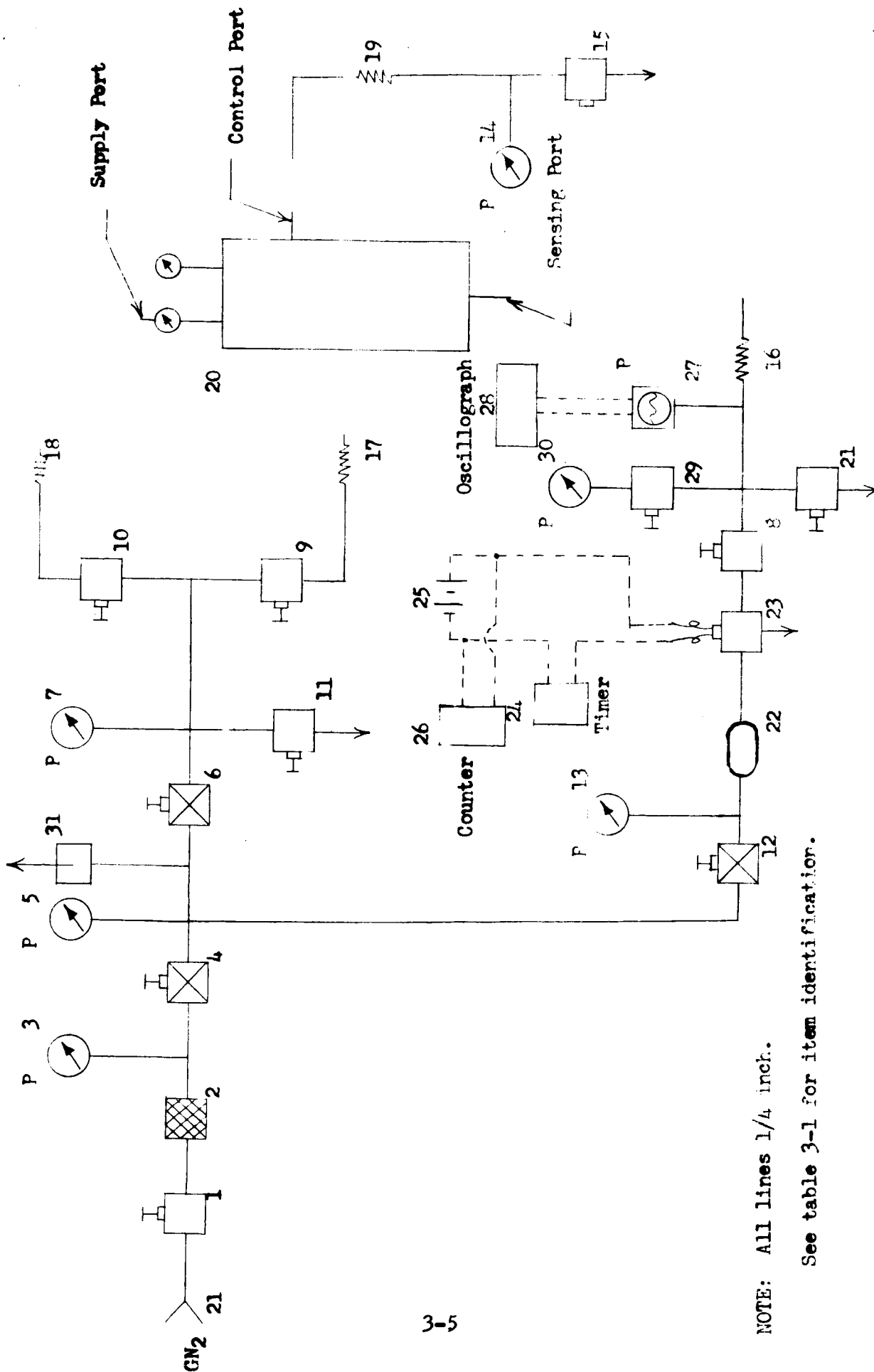
\* Required only for surge test.

\*\* Required only for surge and life cycle tests.

\*\*\* Required only for life cycle test.

Table 3-2. Proof Pressure Test Data

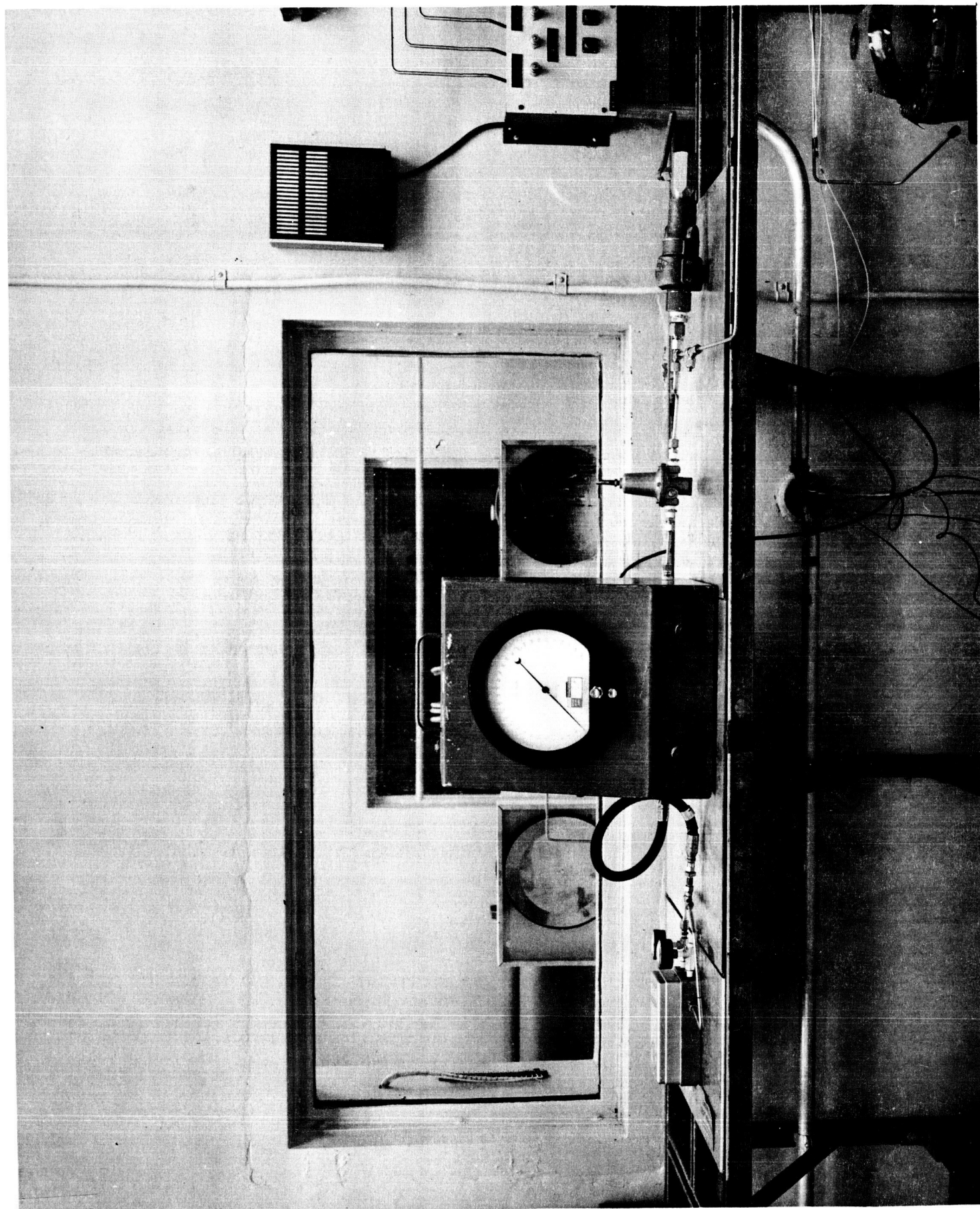
Ports	Proof Pressure (psig)	Time Pressurized (min.)	Results
Sensing	30	5	No leakage or distortion
Supply and Control	30	5	No leakage or distortion



NOTE: All lines 1/4 inch.

See table 3-1 for item identification.

Figure 3-1. General Test Schematic



SECTION IV  
FUNCTIONAL TEST

4.1        TEST REQUIREMENTS

- 4.1.1        With the sensitivity setting at 1 psig per 1 psig and the regulator set for direct action, it shall be verified that a 2 to 18-psig control-port pressure is proportional to a 2 to 18-psig sensing-port pressure. The sensing pressure shall be varied in 4-psig increments. Ten pressure cycles shall be performed initially. For all subsequent functional tests, only three cycles shall be performed.
- 4.1.2        With the regulator set for direct action, it shall be verified that a 3 to 18-psig control-port pressure is proportional to an 8 to 13-psig sensing-port pressure change at a sensitivity setting of 3 psig per 1 psig. The sensing shall be varied in 1-psig increments and the sensing pressure and control pressure shall be recorded. Three cycles shall be performed.
- 4.1.3        With the regulator set for direct action, it shall be verified that a 6 to 12-psig control-port pressure is proportional to a zero to 20-psig sensing-port pressure change at a sensitivity setting of 0.3 psig to 1 psig. The sensing pressure shall be varied in 5-psig increments. Three cycles shall be performed.
- 4.1.4        With the sensitivity setting at 1 psig per 1 psig and the regulator set for reverse action, it shall be verified that a 2 to 18-psig control-port pressure is proportional to an 18 to 2-psig sensing-port pressure. The sensing pressure shall be varied in 4-psig increments. Three cycles shall be performed.
- 4.1.5        With the regulator set for reverse action, it shall be verified that a 3 to 18-psig control-port pressure is proportional to a 13 to 8-psig sensing-port pressure change at a sensitivity setting of 3 psig per 1 psig. The sensing pressure shall be varied in 1-psig increments and the sensing pressure and control pressure shall be recorded. Three cycles shall be performed.
- 4.1.6        With the regulator set for reverse action, it shall be verified that a 6 to 12-psig control-port pressure is proportional to a 20 to zero-psig sensing-port pressure change at a sensitivity setting of 0.3 psig to 1 psig. The sensing pressure shall be varied in 5-psig increments. Three cycles shall be performed.

- 4.1.7 During all phases of testing, the regulator shall be continuously monitored for external leakage. A 20-psig supply-port pressure shall be maintained for all tests. The procedures described in 4.1.1 through 4.1.6 shall be performed for the initial functional test only. For all subsequent functional tests, only the procedures described in 4.1.1 and 4.1.2 shall be performed.
- 4.2 TEST PROCEDURE
- 4.2.1 The test setup was assembled as shown in figures 3-1 and 4-1 using the equipment listed in table 3-1. All hand valves were closed, and all regulators were set for zero outlet pressure.
- 4.2.2 Flex Hose 18 was connected to the supply port of the specimen. Flex Hose 16 was connected to the sensing port, and Flex Hose 19 was connected to the control port.
- 4.2.3 The test specimen was set for direct acting with a sensitivity ratio of 1 to 1.
- 4.2.4 Hand valve 1 was opened and regulator 4 was adjusted to provide a pressure of 50 psig as indicated on gage 5. Hand valve 10 was opened and regulator 6 was set to provide a specimen supply port pressure of 20 psig as indicated on gage 7.
- 4.2.5 Hand valve 8 was opened and regulator 12 was adjusted to provide a 2-psig pressure, as indicated on gage 13, at the sensing port of the specimen. The pressure at the control port, as indicated on gage 14, was recorded. The sensing port pressure was then varied from 2 to 18-psig and back to 2-psig in 4-psig increments with the reading shown on the control pressure gage 14 being recorded at each point.
- 4.2.6 The procedures described in 4.2.5 were performed ten times for the initial functional test and three times for each subsequent functional test.
- 4.2.7 Regulators 6 and 12 were closed, and hand valves 11, 21, and 15 were opened to vent the specimen. Hand valves 11, 21, and 15 were closed.
- 4.2.8 The test specimen was set for direct acting with a sensitivity ratio of 3 to 1.
- 4.2.9 Regulator 6 was adjusted to provide a specimen supply port pressure of 20 psig as indicated on gage 7.

- 4.2.10 Regulator 12 was adjusted to provide a sensing port pressure of 8 psig as indicated on gage 13. The pressure at the control port, as indicated on gage 14, was recorded. The sensing port pressure was then varied from 8 to 13 psig and back to 8 psig in 1-psig increments. The sensing port and control port pressures were recorded at each setting. This procedure was repeated for three cycles.
- 4.2.11 The steps described in 4.2.7 through 4.2.9 were repeated for a sensitivity ratio of 0.3 to 1.
- 4.2.12 Using regulator 12, the sensing port pressure was varied from zero to 20 psig and back to zero psig in 5-psig increments. The sensing port and control port pressures were recorded at each setting. This procedure was repeated for three cycles.
- 4.2.13 The steps described in 4.2.7 through 4.2.9 were then repeated except that the specimen was set for reverse acting with a sensitivity ratio of 1 to 1. The steps described in 4.2.5 were then performed three times.
- 4.2.14 The steps described in 4.2.7 through 4.2.9 were then repeated except that the specimen was set for reverse acting with a sensitivity ratio of 3 to 1. The steps described in 4.2.10 were then performed.
- 4.2.15 The steps described in 4.2.7 through 4.2.9 were then repeated except that the specimen was set for reverse acting with a sensitivity ratio of 0.3 to 1. The steps described in 4.2.12 were performed.
- 4.2.16 Hand valve 1 was closed and hand valves 11, 15, and 21 were opened to vent the system.

#### 4.3

##### TEST RESULTS

All test results were satisfactory. However, the specimen dial adjustment was found to be very coarse, and a slight movement of the indicator resulted in significant changes to the range setting.

#### 4.4

##### TEST DATA

Test data are presented in tables 4-1 through 4-6.

Table 4-1. Functional Test Data for Direct Acting Regulator  
Sensitivity Ratio 1:1

SUPPLY PRESSURE (PSIG)	SENSING PRESSURE (PSIG)	CONTROL PRESSURE (PSIG)										
		REQUIRED	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	RUN 9	RUN 10
20	18	18	17.9	17.9	18.2	18.2	18.1	18.1	18.2	18.2	18.1	18.1
20	14	14	13.6	13.1	14.4	13.4	14.2	13.4	14.2	13.4	14.1	13.4
20	10	10	9.6	9.1	10.4	9.4	10.3	9.4	10.4	9.3	10.3	9.2
20	6.0	6.0	5.7	5.0	6.4	5.5	6.4	5.4	6.3	5.6	6.2	5.4
20	2.0	2.0	2.0	2.0	1.4	2.0	2.0	2.0	2.0	1.9	1.9	1.8

Table 4-2. Functional Test Data for Direct Acting Regulator  
Sensitivity 3:1

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
20	8	3	4.4	4.4	4.1
20	9.0	6	6.4	6.6	6.6
20	10.0	9	9.2	9.8	9.0
20	11.0	12	12.0	12.1	12.0
20	12.0	15	15.0	15.2	14.5
20	13.0	18	18.0	18.3	18.3

Note: Sensitivity dial setting was approximately 0.8.

Table 4-3. Functional Test Data for Direct Acting Regulator  
Sensitivity 0.3 Psig/1.0 Psig

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
20	0	6.0	6.0	5.9	5.9
20	5	7.5	7.5	7.2	7.4
20	10	9.0	8.9	8.5	8.6
20	15	10.5	10.2	9.9	10.4
20	20	12.0	11.5	11.5	11.4

Table 4-4. Functional Test Data for Reverse Acting Regulator  
Sensitivity 1.0 Psig/1.0 Psig

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
20	18.0	2.0	1.9	1.9	1.9
20	14.0	6.0	5.4	6.2	5.4
20	10.0	10.0	9.3	10.4	9.0
20	6.0	14.0	13.3	14.1	13.2
20	20.0	20.0	18.0	17.9	17.9

Table 4-5. Functional Test Data for Reverse Acting Regulator  
Sensitivity 3.0 Psig/1.0 Psig

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
20	18.0	18.0	17.9	18.3	19.0
20	9.0	15.0	14.4	15.0	15.1
20	10.0	12.0	11.0	12.2	12.2
20	11.0	9.0	8.3	9.0	9.1
20	12.0	6.0	5.5	5.6	6.4
20	13.0	3.0	3.0	3.1	3.0

Table 4-6. Functional Test Data for Reverse Acting Regulator  
Sensitivity 0.3 Psig/1.0 Psig

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
20.	0	12.0	12.2	12.0	12.0
20	5	10.5	10.3	10.6	10.0
20	10	9.0	8.8	9.4	8.5
20	15	7.5	7.2	7.9	6.9
20	20	6.0	5.8	6.0	5.6



## SECTION V

### SURGE TEST

#### 5.1 TEST REQUIREMENTS

- 5.1.1 The supply port of the specimen shall be pressurized from zero to 20 psig within 100 milliseconds and slowly relieved back to zero psig. The specimen shall be subjected to 25 cycles.
- 5.1.2 A functional test shall be conducted immediately following the completion of this test.

#### 5.2 TEST PROCEDURE

- 5.2.1 The surge test setup was assembled as shown in figures 3-1 and 5-1 using the equipment listed in table 5-1.
- 5.2.2 Flex Hose 16 was connected to the supply port of the specimen. The control and sensing ports of the specimen were vented to the atmosphere. All hand valves were closed and all regulators were adjusted for zero outlet pressure.
- 5.2.3 Hand valve 1 was opened. Regulator 4 was adjusted to provide a pressure of 50 psig as indicated on gage 5. Regulator 12 was adjusted to provide a pressure of 20 psig as indicated on gage 13. Hand valve 8 was opened.
- 5.2.4 Timer 24 was set to cycle solenoid valve 23 at approximately 30 cycles per minute. A continuous pressure history of each surge, as indicated by transducer 27, was recorded on oscillograph recorder 28. It was verified that the surge from zero to 20 psig occurred within 100 milliseconds.
- 5.2.5 A total of 25 cycles were performed.
- 5.2.6 Following completion of the surge test, a functional test was performed.

#### 5.3 TEST RESULTS

The results were satisfactory. The specimen was not damaged by the surge pressures, and it functioned satisfactorily following the test.

#### 5.4 TEST DATA

- 5.4.1 Test data are presented in tables 5-1 and 5-2.
- 5.4.2 A typical surge waveform is presented in figure 5-2.

Table 5-1. Functional Test Data Obtained After Surge Test  
Direct Acting Regulator, Sensitivity 1.0 Psig/1.0 Psig

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
20.0	2.0	2.0	1.8	1.0	2.4
20.0	6.0	6.0	6.2	5.0	6.5
20.0	10.0	10.0	10.0	8.6	10.5
20.0	14.0	14.0	13.8	13.0	14.3
20.0	20.0	20.0	17.7	17.7	18.2

Table 5-2. Functional Test Data Obtained After Surge Test  
Direct Acting Regulator, Sensitivity 3.0 Psig/1.0 Psig

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
20.0	8.0	3.0	3.3	2.7	2.7
20.0	9.0	6.0	5.7	5.0	5.0
20.0	10.0	9.0	8.6	7.4	8.2
20.0	11.0	12.0	11.2	10.5	10.9
20.0	12.0	15.0	14.4	13.6	13.9
20.0	13.0	18.0	17.2	17.2	16.9

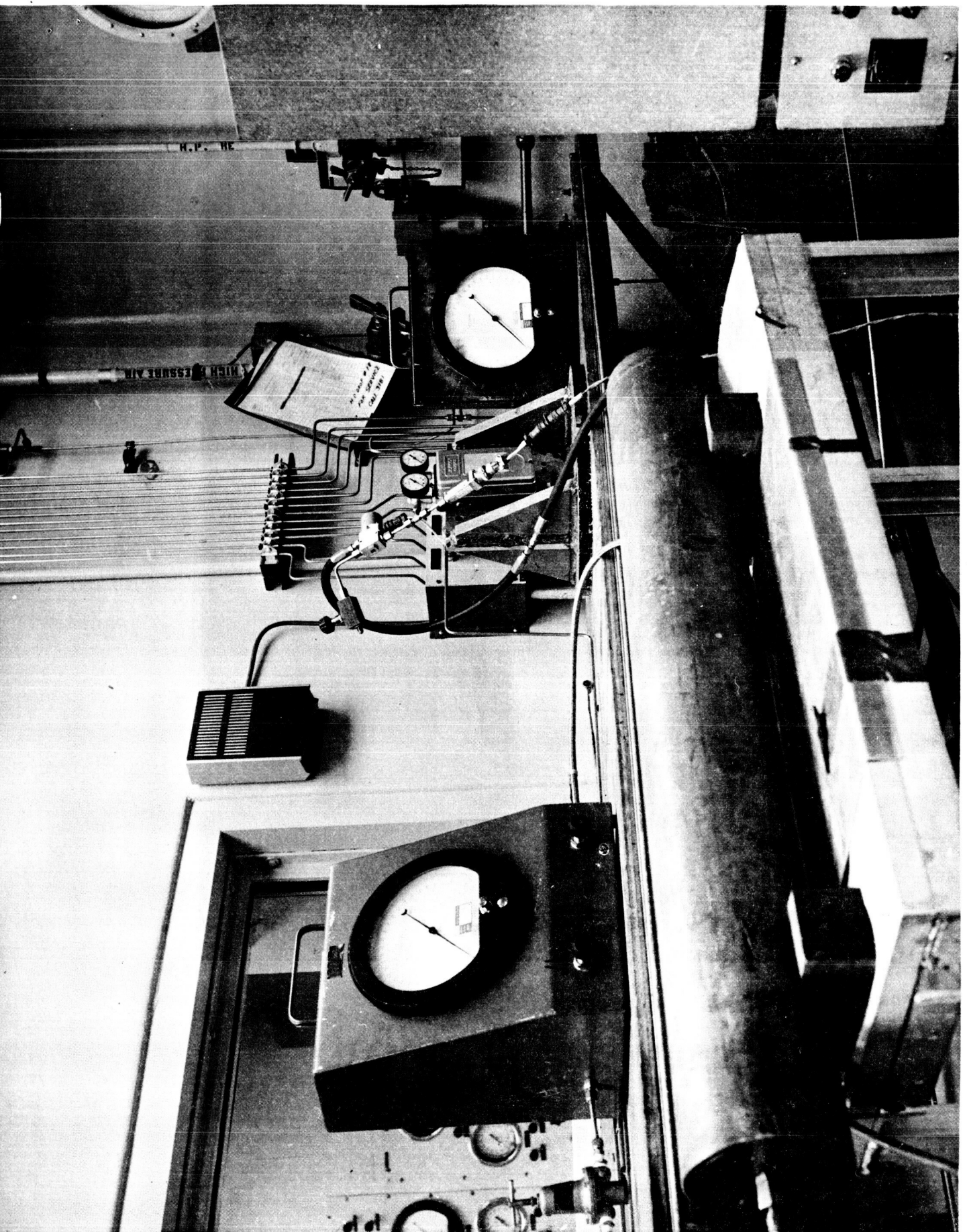


Figure 5-1. Surge Test Setup

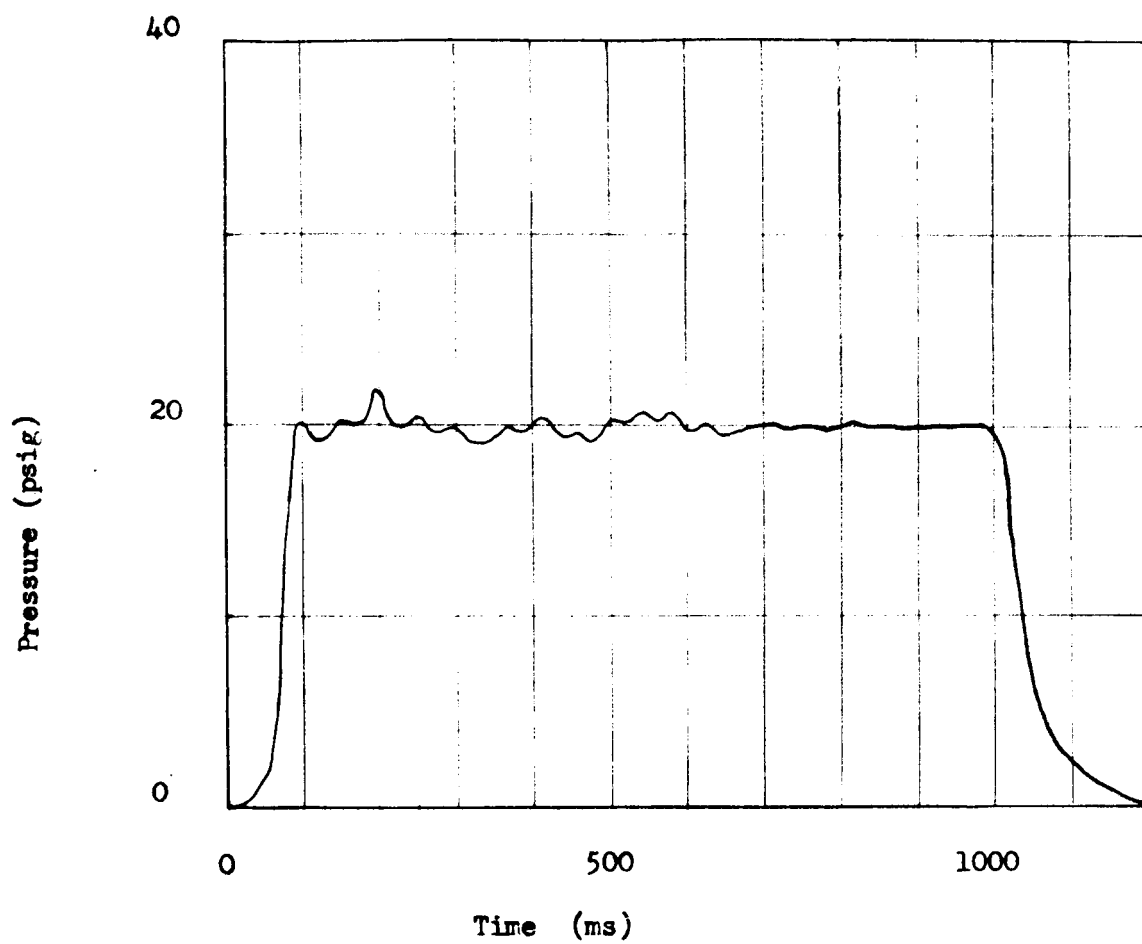


Figure 5-2. Typical Surge Waveform

## SECTION VI

### VIBRATION TEST

#### 6.1 TEST REQUIREMENTS

- 6.1.1 A vibration test will be performed to determine the capability of the regulator to operate satisfactorily during and after being subjected to vibration.
- 6.1.2 The test shall be performed in two axes as shown in figure 6-1.
- 6.1.3 The failure envelope shall be established by testing the specimen in accordance with a procedure Ia, Section 9, KSC-STD-164(D), with the exception of the sinusoidal search, where the maximum input level shall not exceed 10.0g at any frequency.
- 6.1.4 Acceleration shall be measured at the test specimen using accelerometers mounted on the specimen and shall be controlled by an accelerometer mounted on the fixture base.
- 6.1.5 With the sensitivity setting at 1 psig per 1 psig and the regulator set for direct acting, the proportionality of control port pressure to sensing port pressure shall be verified at sensing port pressures of 2, 10, and 18 psig. Sensing port pressure shall be varied periodically during vibration periods, and control port pressure shall be continuously monitored.
- 6.1.6 A functional test shall be performed before and at the completion of vibration in each axis.

#### 6.2 TEST PROCEDURE

- 6.2.1 The specimen was mounted on the vibrator as shown in figure 6-1, 6-2, and 6-3 utilizing the equipment listed in table 6-1.
- 6.2.2 A functional test was performed as more than 72 hours had elapsed since the last functional test.
- 6.2.3 The sensitivity of the specimen was set at 1 psig per 1 psig direct acting. During each period of vibration, the supply port was pressurized through regulator 15 to 20 psig as indicated on gage 16 and the sensing port successively pressurized through regulator 6 to 2, 10, and 18 psig as indicated on gage 7. The outlet port

pressure was continuously monitored on gage 10 to verify the 1 to 1 proportionally ratio.

6.2.4            RESONANT FREQUENCY SEARCH

6.2.4.1        The specimen was vibrated at an input of 1g peak over a frequency range of 5 to 2000 to 5 cps.

6.2.4.2        The sweep was logarithmic and 15 minutes in duration.

6.2.4.3        All resonant frequencies were noted and recorded.

6.2.5           SINUSOIDAL SEARCH

6.2.5.1        The specimen was vibrated at each of the 1/3-octave band-width center frequencies within a frequency range of 10 to 2000 cps. Table 6-2 lists the 1/3 octave center frequencies and the input level.

6.2.5.2        The input level was increased at each 1/3 octave center frequency until functional degradation occurred or until the maximum level was attained. The level of the first indication of degradation was recorded.

6.2.5.3        The 1/3 octave center frequencies above and below 62 cps at which the lowest acceleration input level caused functional degradation were noted. The region of the frequency range, including these 1/3 octave center frequencies, was investigated by sweeping at a scanning speed of 3.1 degrees per minute on each side of the noted frequency. The g input level was decreased from the minimum g level recorded above by 1g increments or by 10 percent, whichever was less, until no malfunction of the test specimen was observed. The g level was noted.

6.2.5.4        At the completion of the search, a sinusoidal sweep test was conducted at levels specified by a test envelope derived from the information gained in 6.2.5.1, 6.2.5.2, and 6.2.5.3. The test envelope was determined by the testing agency to: (1) subject the test specimen to the maximum acceleration levels possible without causing functional degradation, and (2) to maintain an envelope level without numerous changes of slope.

6.2.5.5        The test envelope was scanned at a logarithmic rate between 10 and 2000 cps for a total test time of 15 minutes (7.5 minutes up and 7.5 minutes back).

6.2.5.6        The specimen was functionally tested after this test was completed.

6.2.6           RANDOM SEARCH

The specimen was exposed to white noise random vibration over the frequency range encompassing the critical frequencies determined in 6.2.4. The test PSD level ( $g^2/cps$ ) was determined according to the following formula:

$$PSD = \frac{(G_c/3)^2}{f_{c_h} - f_{c_l}}$$

where:  $G_c$  = lowest sinusoidal  $g$  level at which functional degradation occurred

$f_{c_h}$  = highest critical frequency

$f_{c_l}$  = lowest critical frequency

This formula does not imply a relationship between the sinusoidal test level and the random test level, but is only intended to provide a rule-of-thumb for establishing an initial PSD search level. The PSD level was increased until functional degradation occurred, to a maximum of  $0.20 g^2/cps$ , or was decreased until degradation did not occur. The total test time was 5 minutes. The specimen was functionally tested after this test was completed.

6.2.7 The resonant frequency search, sinusoidal search, and random search constituted one axis of vibration and were completed before going to the next axis.

6.2.8 All test data were recorded.

### 6.3 TEST RESULTS

6.3.1 Test results were satisfactory.

6.3.2 During the resonant frequency search in the x-axis, resonant frequencies were noted at 26, 170, and 1600 cps during the upswing and at 200, 28, and 20 cps during the downswing.

6.3.3 During the sinusoidal search in the x-axis, functional degradation occurred at the 1/3-octave center frequencies shown in table 6-6. The levels shown in this table were used to form the test envelope shown in figure 6-4. The specimen was readjusted after each degradation.

6.3.4 No functional degradations were noted when the test envelope was run.

6.3.5

No functional degradation occurred during the resonant search, sinusoidal search, or random search in the y-axis.

6.4

#### TEST DATA

The results of functional tests performed before and after the vibration periods are contained in tables 6-3 and 6-4. Table 6-5 presents resonant frequencies recorded during vibration sweeps. Results of the sinusoidal search are contained in table 6-6. Vibration envelopes within which the specimen performed satisfactorily are shown in figures 6-4 through 6-7.

Table 6-1. Vibration Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Johnson Service Company	R-990	NA	Pressure Regulator, 0 to 20-psig
2	GN <sub>2</sub> Source	CCSD	NA	NA	100-psig
3	Hand Valve	Robbins	SSKA250-4T	NA	1/4-inch
4	Filter	Bendix	1731261	NA	2-micron
5	Pressure Gage	U. S. Gage	1800T	NASA 95-1428 -B	0 to 160-psig + 2% accuracy Calibration date: 10/7/66
6	Pressure Regulator	Watts	119-3	NA	0 to 20-psig outlet
7	Pressure Gage	Heise	NA	NASA 014229	0 to 30-psig +0.25% FS accuracy Calibration date: 11/3/66
8	Flex Hose	Resistoflex	R2203-4	NA	1/4-inch
9	Flex Hose	Resistoflex	R2203-4	NA	1/4-inch
10	Pressure Gage	Martin-Decker	B-760-150	NA	0 to 60-psig +0.25% FS accuracy Calibration date: 9/18/66
11	Accelerometer	Endevco Co.	2220	NA	Accuracy: 3.5% amplitude; 1.5% or 2 cps fre- quency
12	Control Accelerometer	Endevco Co.	2217	HC72	Accuracy: 3.5% amplitude; 1.5% or 2 cps fre- quency

Table 6-1. Vibration Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
13	Fixture	CCSD	NA	NA	Provided by CCSD-FO
14	Vibration System	MB Electronics	C210	NA	To provide up to 10g, 5 to 3000 cps
15	Regulator	Watts	119-3	NA	0 to 20-psig outlet
16	Pressure Gage	Heise	NA	NASA 95-1637 -B	0 to 100-psig +0.25% FS accuracy Calibration date: 10/17/66

Table 6-2. One-Third Octave Center Frequencies

1/3-Octave Bandwidth Frequencies (cps)	Maximum Input (g level)
10	1.3
12.5	2.0
16	3.4
20	5.1
25	8.2
28	10.0
40	10.0
50	10.0
62	10.0
80	10.0
100	10.0
125	10.0
160	10.0
200	10.0
250	10.0
320	10.0
400	10.0
500	10.0
630	10.0
800	10.0
1000	10.0
1250	10.0
1600	10.0
2000	10.0

Table 6-3. Pre-Vibration Functional Test Data

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)						
		Required	X-axis			Y-axis		
			Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
* Sensitivity Ratio 1:1								
20.0	2	2.0	2.0	2.2	1.6	2.0	2.5	2.5
20.0	6	6.0	6.2	6.3	6.0	8.0	8.0	6.9
20.0	10	10.0	10.2	10.4	10.0	11.0	11.0	11.0
20.0	14	14.0	13.9	14.25	13.8	15.8	15.0	14.9
20.0	18	18.0	18.0	18.3	17.2	18.3	18.7	18.9
20.0	14	14.0	13.5	13.7	13.2	14.1	14.3	14.4
20.0	10	10.0	9.3	9.45	9.3	10.1	10.3	10.1
20.0	6	6.0	5.3	5.4	5.3	7.3	6.4	6.3
20.0	2	2.0	1.6	1.4	1.6	2.1	2.3	2.1
** Sensitivity Ratio 3:1								
20.0	8	3.0	4.3	4.0	3.6	3.8	4.1	3.9
20.0	9	6.0	7.1	6.5	6.8	7.4	6.9	7.2
20.0	10	9.0	9.3	9.4	9.3	10.1	9.8	9.9
20.0	11	12.0	12.1	12.4	12.1	12.5	12.6	12.4
20.0	12	15.0	15.0	15.0	14.6	15.2	15.4	14.9
20.0	13	18.0	17.9	17.85	18.0	18.5	18.4	18.3
20.0	12	15.0	14.9	14.5	14.7	15.2	14.1	14.7
20.0	11	12.0	11.9	11.9	11.8	12.1	11.95	11.4
20.0	10	9.0	9.1	9.0	9.0	9.2	8.75	9.0
20.0	9	6.0	6.4	6.3	6.3	6.4	6.5	6.6
20.0	8	3.0	4.0	3.8	3.4	3.6	4.0	3.5

\* X - axis Dial setting - 83.5 psi

Y - axis Dial setting - 79 psi

\*\* X - axis Dial setting - 81 psi

Y - axis Dial setting - 78 psi

Table 6-4. Sinusoidal Vibration Functional Test Data

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)						
		Required	X-axis			Y-axis		
			Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Sensitivity Ratio 1:1 *								
20.0	2	2	2.0	2.0	2.1	1.8	2.1	2.2
20.0	6	6	6.3	6.3	6.5	7.5	6.6	7.6
20.0	10	10	10.35	10.5	10.4	10.4	10.4	10.55
20.0	14	14	14.25	14.4	14.4	14.2	14.3	14.3
20.0	18	18	18.0	18.3	18.3	18.1	18.2	18.2
20.0	14	14	13.55	13.85	13.7	13.6	13.6	13.8
20.0	10	10	9.5	9.7	9.65	9.75	9.8	9.8
20.0	6	6	5.85	5.9	5.8	6.0	7.0	7.0
20.0	2	2	1.8	1.8	1.9	2.1	2.1	2.2
Sensitivity Ratio 3:1 **								
20.0	8	3.0	3.5	3.3	3.3	2.9	3.1	3.5
20.0	9	6.0	6.5	6.2	6.0	5.95	6.3	6.5
20.0	10	9.0	9.0	9.0	9.0	8.8	9.1	9.1
20.0	11	12.0	11.7	11.6	11.5	11.6	11.9	11.7
20.0	12	15.0	14.3	14.3	14.1	14.2	14.4	14.4
20.0	13	18.0	18.0	17.0	17.1	17.2	17.4	17.7
20.0	12	15.0	14.1	13.6	13.6	13.9	14.2	13.5
20.0	11	12.0	11.3	11.3	11.2	10.9	10.9	11.1
20.0	10	9.0	8.4	8.4	8.4	8.2	8.8	8.8
20.0	9	6.0	5.4	5.8	5.7	5.9	5.8	6.2
20.0	8	3.0	3.2	3.4	3.3	3.1	3.7	3.0

\* X-axis Dial Setting - 77 psi

Y-axis Dial Setting - 75 psi

\*\* X-axis Dial Setting - 78 psi

Y-axis Dial Setting - 77.5 psi

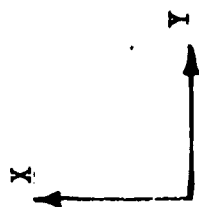
Table 6-5. Resonant Frequency Search Data

Axis	Resonant Frequencies (cps)	
	Downsweep	Upsweep
X	200	26
	28	170
	20	1600
Y	None	None

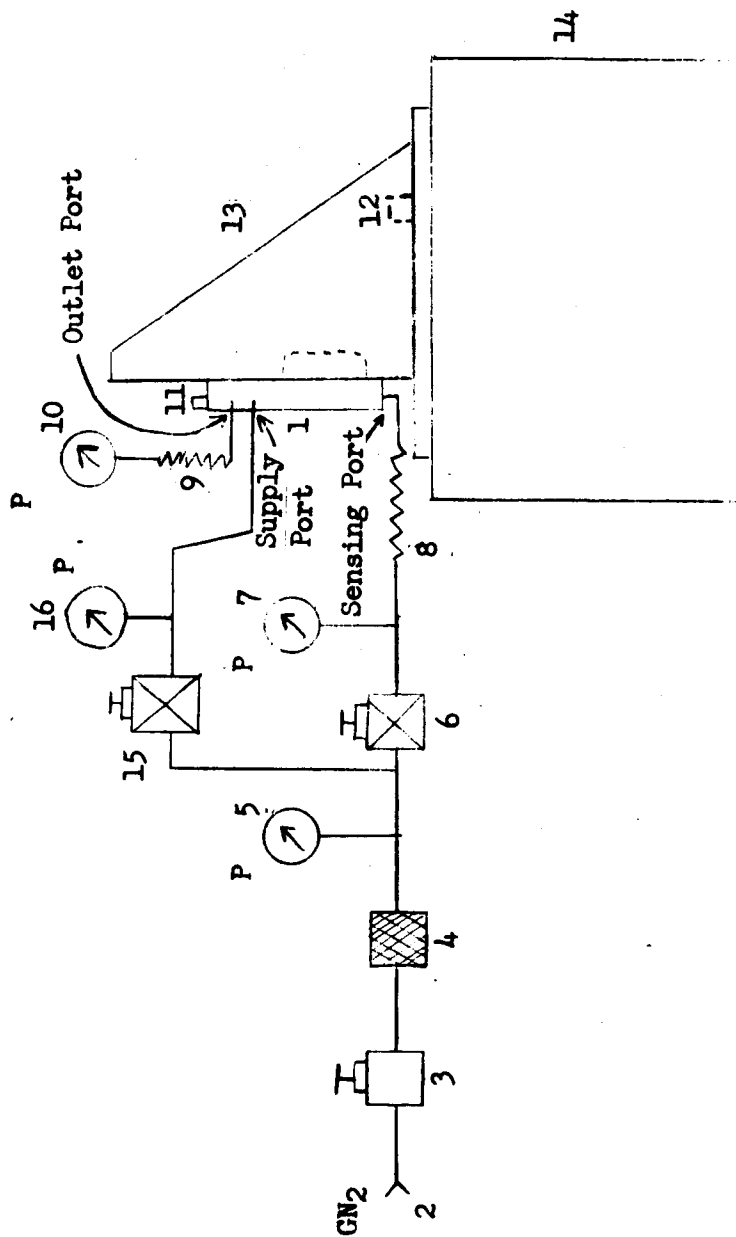
Note: Data obtained for 0 to 2000 to 0 cps at 1 g peak.  
Test duration was 15 minutes.

Table 6-6. Sinusoidal Search Data

1/3-Octave Bandwidth Frequencies (cps)	Desired g-level	Actual g Level X-axis	Actual g Level Y-axis
10.0	1.3	0.7	1.3
12.5	2.0	0.7	2.0
16.0	3.4	1.1	3.4
20.0	5.1	5.1	5.1
25.0	8.2	6.0	8.2
28.0	10.0	10.0	10.0
40.0	10.0	10.0	10.0
50.0	10.0	10.0	10.0
62.0	10.0	10.0	10.0
80.0	10.0	10.0	10.0
100.0	10.0	10.0	10.0
125.0	10.0	10.0	10.0
160.0	10.0	10.0	10.0
200.0	10.0	10.0	10.0
250.0	10.0	10.0	10.0
320.0	10.0	10.0	10.0
400.0	10.0	10.0	10.0
500.0	10.0	10.0	10.0
630.0	10.0	10.0	10.0
800.0	10.0	10.0	10.0
1000.0	10.0	10.0	10.0
1250.0	10.0	10.0	10.0
1600.0	10.0	10.0	10.0
2000.0	10.0	10.0	10.0



Axis Designation



Note: All lines 1/4 inch.

See table 6-1 for item identification.

Figure 6-1. Vibration Test Schematic

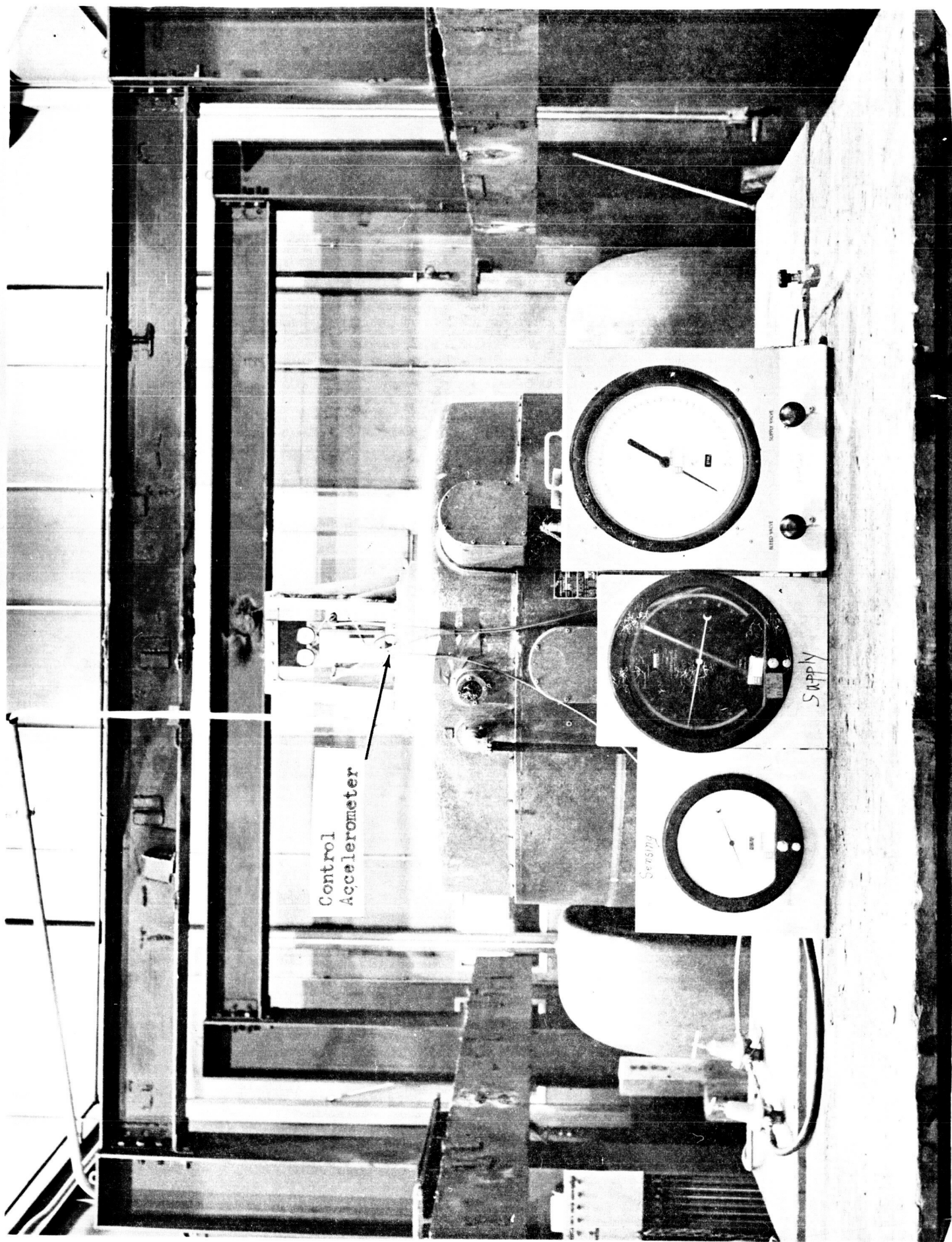
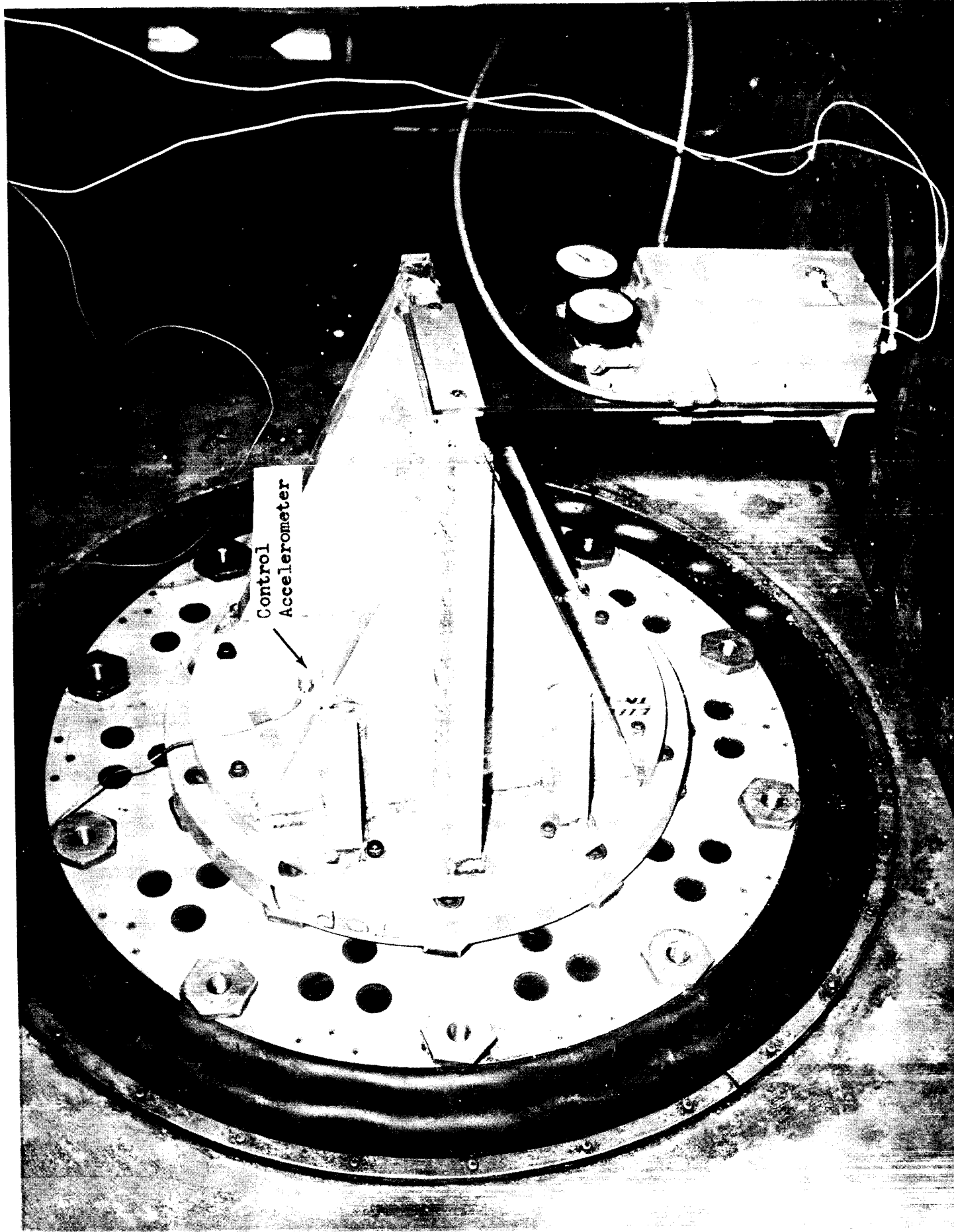


Figure 6-2. Vibration Setup X-Axis



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3197

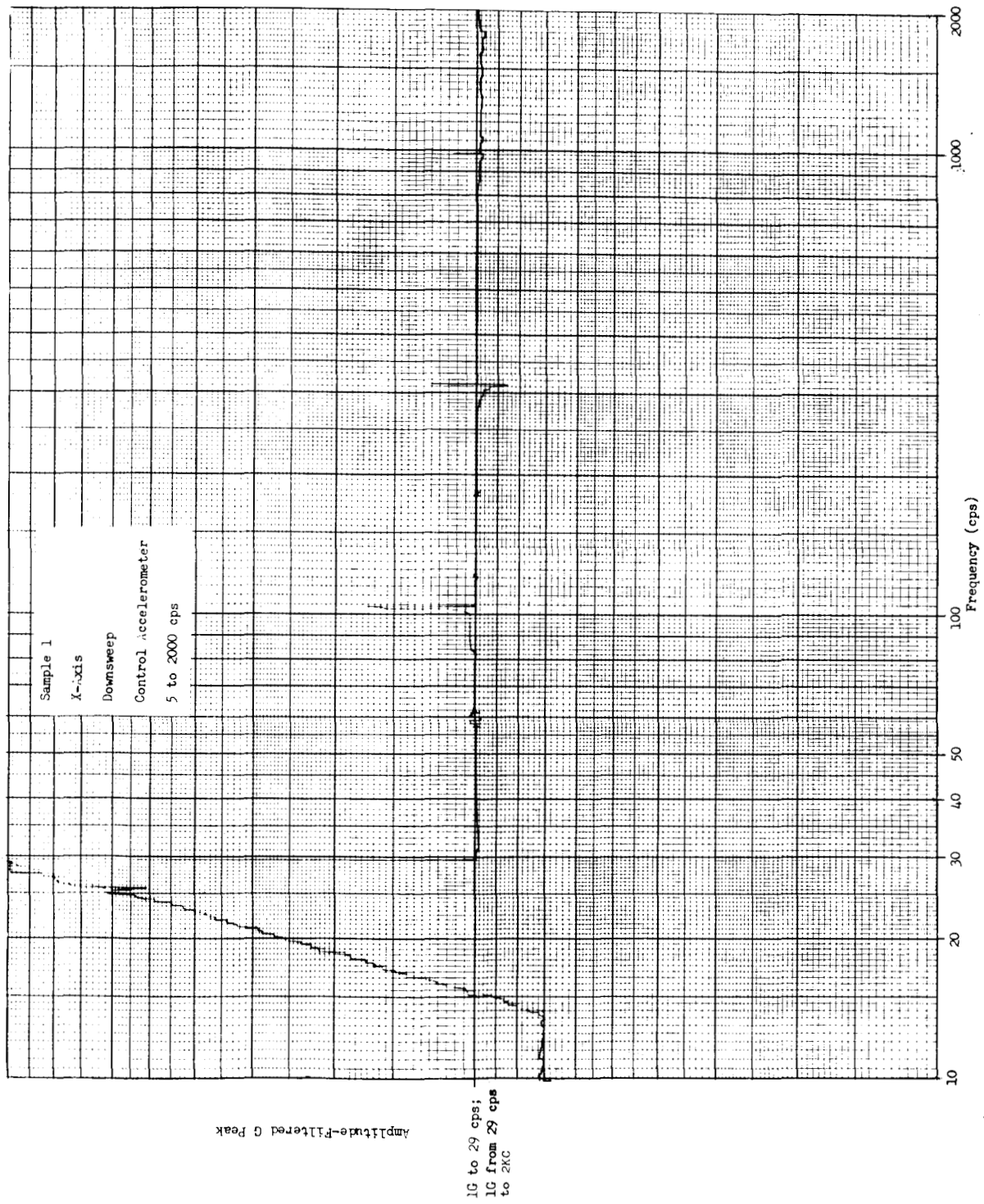


Figure 6-4. Sinusoidal Test Envelope, X-Axis

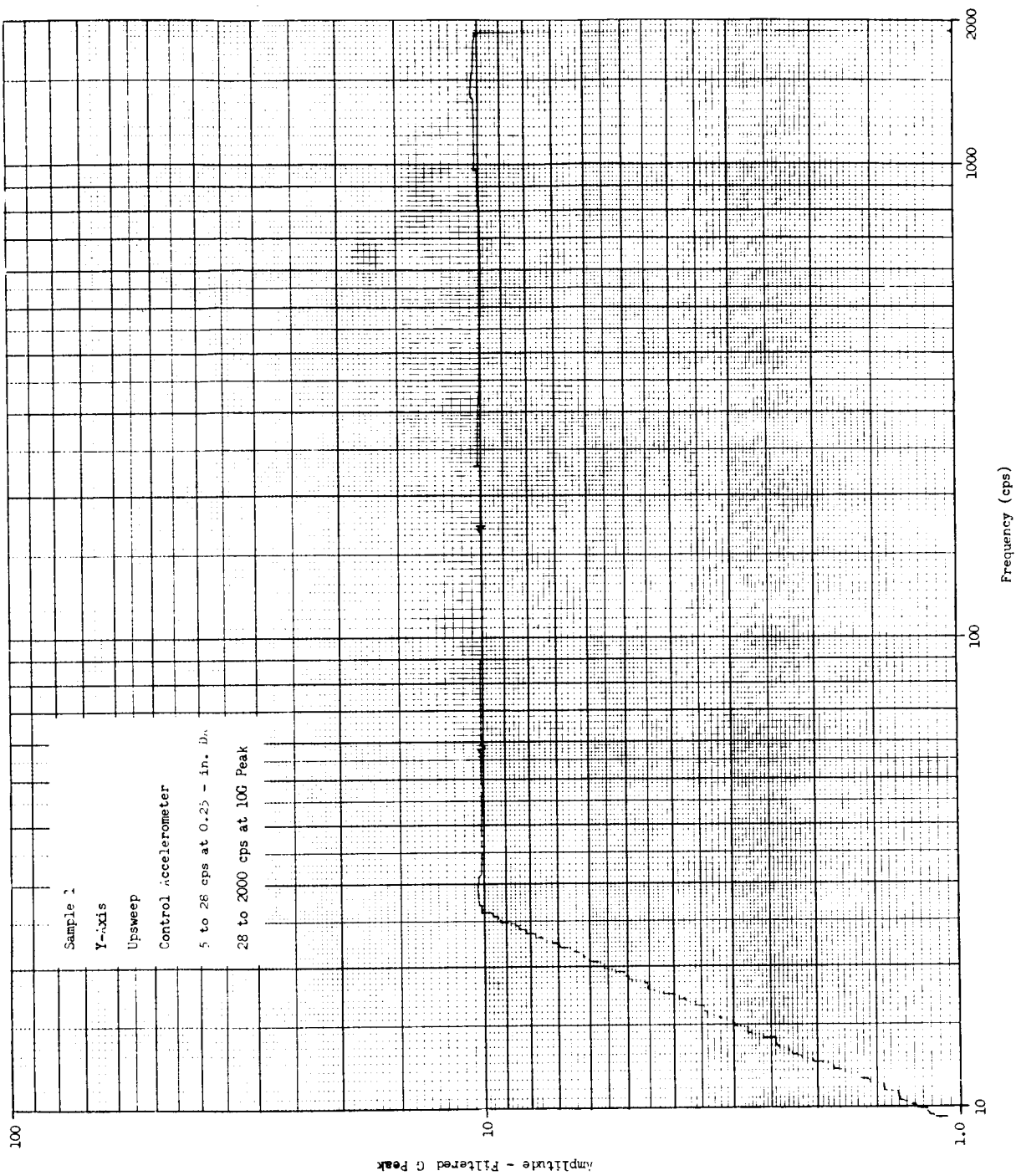


Figure 6-5. Simusoidal Test Envelope, Y-Axis

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397

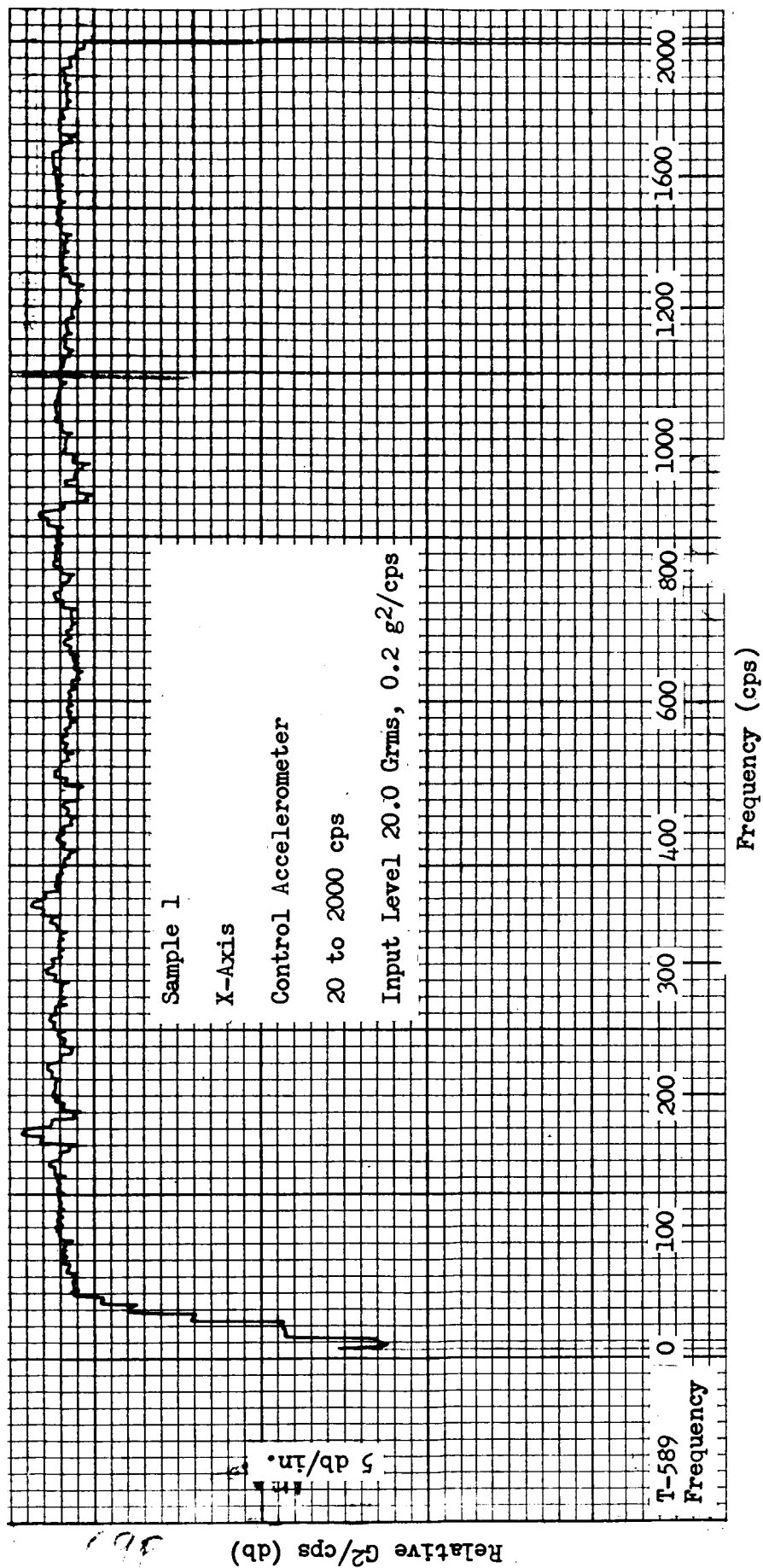


Figure 6-6. Random Test Envelope, X-Axis

27139/3197

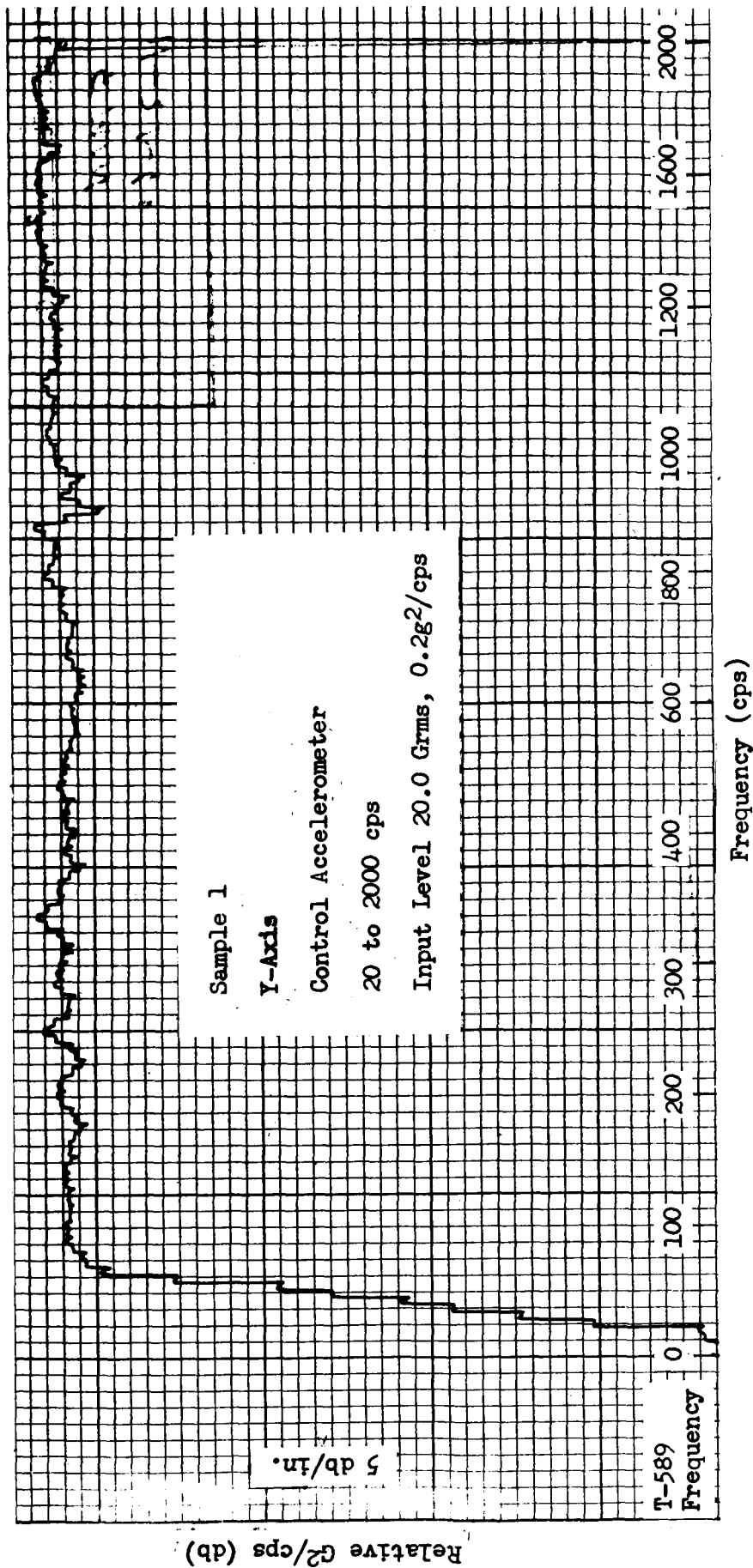


Figure 6-7. Random Test Envelope, Y-Axis

## SECTION VII

### OPERATIONAL CYCLING TEST

#### 7.1 TEST REQUIREMENTS

- 7.1.1 The test specimen shall be subjected to 5000 cycles of operation.
- 7.1.2 A cycle shall consist of varying the sensing pressure from 1 to 20 psig and back to 1 psig.
- 7.1.3 The pressure regulator shall be set at a sensitivity ratio of 1 psig to 1 psig in the direct-acting mode.
- 7.1.4 A functional test shall be performed after 100, 500, and 1000 cycles, and each 1000 cycles thereafter.

#### 7.2 TEST PROCEDURE

- 7.2.1 The test setup was assembled as shown in figures 3-1 and 7-1 utilizing the equipment listed in table 3-1. The specimen was set for direct acting with a sensitivity ratio of 1 to 1.
- 7.2.2 Flex Hose 18 was connected to the supply port of the specimen, Flex Hose 16 was connected to the sensing port, and Flex Hose 19 was connected to the control port. All hand valves were closed and all regulators were set for zero outlet pressure.
- 7.2.3 Hand valve 1 was opened and regulator 4 was adjusted to provide a pressure of 50 psig as indicated on gage 5. Hand valve 10 was opened and regulator 6 was adjusted to provide a specimen supply port pressure of 20 psig as indicated on gage 7.
- 7.2.4 Regulator 12 was adjusted to provide a pressure of 20 psig as indicated on gage 13. Hand valve 29 was opened and hand valve 8 was cracked slightly.
- 7.2.5 Timer 24 was set to cycle solenoid valve 23 at approximately 15 cycles per minute. Hand valve 8 was adjusted as required to allow the sensing port pressure of the specimen as indicated by gage 30, to vary smoothly from 1 to 20 psig and back to 1 psig during each cycle of solenoid valve 23.
- 7.2.6 A total of 5000 cycles, as indicated on counter 26, were performed. The specimen control port pressure, as indicated on gage 14, was observed during cycling operation.

to detect any change in operating characteristics of the specimen.

7.2.7 Functional tests were performed after 100, 500, 1000, 2000, 3000, 4000, and 5000 cycles. At the completion of the final functional test, the specimen was visually inspected for damage or wear.

### 7.3 TEST RESULTS

Test results were considered satisfactory. However, it should be noted that the specimen required a slightly different dial setting each time it was readjusted during or following a functional test. Also, the setting was very critical as reported in 4.3.1 and a very small shift resulted in erroneous readings.

### 7.4 TEST DATA

Test data are presented in tables 7-1 through 7-8.

Table 7-1. Functional Test Data Obtained Before Operational Cycle Test

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
Sensitivity Ratio 1:1 *					
20	2	2	2.3	2.2	2.2
20	6	6	6.8	5.8	6.5
20	10	10	10.8	10.7	10.6
20	14	14	14.5	14.6	14.5
20	18	18	18.4	18.6	18.3
20	14	14	13.5	13.8	13.8
20	10	10	9.7	10.0	9.8
20	6	6	6.0	5.7	5.8
20	2	2	2.0	1.8	1.8
**					
Sensitivity Ratio 3:1					
20	8	3	3.0	3.6	3.6
20	9	6	6.4	6.5	6.4
20	10	9	9.4	9.5	9.4
20	11	12	11.8	12.0	12.2
20	12	15	15.0	14.6	14.6
20	13	18	17.8	17.6	17.8
20	12	15	13.9	13.8	13.8
20	11	12	11.0	10.8	10.6
20	10	9	8.0	8.0	7.8
20	9	6	5.4	5.2	5.3
20	8	3	2.4	2.2	2.4

\* Dial Setting 76.5 psi

\*\* Dial Setting 77.0 psi

Table 7-2. Functional Test Data Obtained After 100 Cycles

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
Sensitivity Ratio 1:1 *					
20	2	2	2.0	2.4	2.2
20	6	6	6.4	6.8	6.8
20	10	10	10.1	10.6	10.8
20	14	14	14.0	14.4	14.4
20	18	18	18.4	18.6	18.3
20	14	14	13.8	13.8	14.0
20	10	10	10.0	10.2	10.0
20	6	6	6.4	6.2	6.0
20	2	2	2.4	2.2	2.0
Sensitivity Ratio 3:1 **					
20	8	3	3.5	3.7	3.2
20	9	6	6.8	6.7	6.3
20	10	9	9.4	9.6	9.4
20	11	12	12.0	12.0	11.8
20	12	15	14.9	14.7	14.6
20	13	18	17.8	18.1	17.8
20	12	15	14.2	14.1	14.2
20	11	12	11.2	11.3	11.3
20	10	9	8.8	8.7	8.5
20	9	6	6.0	5.8	5.6
20	8	3	3.1	3.1	3.2

\* Dial setting 76.0 psi

\*\* Dial setting 77.0 psi

Table 7-3. Functional Test Data Obtained After 500 Cycles

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
Sensitivity Ratio 1:1 *					
20	2	2	2.0	2.3	2.3
20	6	6	6.5	6.6	6.4
20	10	10	10.4	10.6	10.6
20	14	14	14.4	14.6	14.6
20	18	18	18.8	18.4	18.4
20	14	14	14.2	14.0	14.1
20	10	10	10.2	10.0	10.3
20	6	6	6.2	6.0	6.2
20	2	2	2.0	2.0	2.1
**					
Sensitivity Ratio 3:1					
20	8	3	3.2	3.0	3.6
20	9	6	6.6	6.4	6.8
20	10	9	9.4	9.3	9.8
20	11	12	12.1	12.1	12.8
20	12	15	15.0	14.8	15.0
20	13	18	18.0	17.8	18.4
20	12	15	14.6	14.2	14.7
20	11	12	11.2	11.8	11.8
20	10	9	8.8	8.8	9.0
20	9	6	5.7	6.0	6.4
20	8	3	2.6	3.2	3.5

\* Dial setting 72.0 psi

\*\* Dial setting 75.5 psi

Table 7-4. Functional Test Data Obtained After 1000 Cycles

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
Sensitivity Ratio 1:1 *					
20	2	2	2.2	2.2	2.3
20	6	6	6.3	6.4	6.4
20	10	10	10.1	10.2	10.3
20	14	14	14.1	14.0	14.2
20	18	18	18.2	18.2	18.2
20	14	14	13.6	13.8	13.8
20	10	10	9.8	9.8	9.8
20	6	6	5.6	5.8	6.0
20	2	2	1.6	1.8	1.6
Sensitivity Ratio 3:1 **					
20	8	3	3.2	3.5	3.8
20	9	6	6.4	6.3	6.5
20	10	9	9.2	9.3	9.3
20	11	12	12.1	12.1	12.0
20	12	15	14.6	14.4	14.6
20	13	18	18.0	17.8	17.7
20	12	15	14.0	13.8	13.8
20	11	12	11.0	10.6	11.0
20	10	9	8.4	8.2	8.0
20	9	6	5.6	5.6	5.8
20	8	3	3.0	2.5	3.3

\* Dial setting 77.0 psi

\*\* Dial setting 78.0 psi

Table 7-5. Functional Test Data Obtained After 2000 Cycles

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
* Sensitivity Ratio 1:1					
20	2	2	2.4	2.5	2.5
20	6	6	6.4	6.5	6.7
20	10	10	10.4	10.6	10.5
20	14	14	14.1	14.3	14.3
20	18	18	18.2	18.2	18.2
20	14	14	13.8	13.8	14.0
20	10	10	10.0	10.0	10.0
20	6	6	6.0	6.0	5.8
20	2	2	2.2	2.1	2.1
** Sensitivity Ratio 3:1					
20	8	3	3.6	4.0	3.8
20	9	6	6.6	6.9	6.8
20	10	9	9.6	9.7	9.6
20	11	12	12.3	12.4	12.4
20	12	15	15.0	15.1	15.0
20	13	18	18.0	18.3	18.3
20	12	15	14.7	14.5	14.4
20	11	12	11.8	11.4	11.8
20	10	9	8.8	8.8	8.5
20	9	6	6.0	6.0	5.8
20	8	3	3.1	3.0	2.8

\* Dial setting 74.0 psi

\*\* Dial setting 76.0 psi

Table 7-6. Functional Test Data Obtained After 3000 Cycles

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
Sensitivity Ratio 1:1 *					
20	2	2	2.0	2.3	2.3
20	6	6	6.6	6.3	6.4
20	10	10	10.6	10.3	10.3
20	14	14	14.5	14.4	14.4
20	18	18	18.4	18.4	18.3
20	14	14	14.0	13.8	14.0
20	10	10	10.0	9.8	9.6
20	6	6	5.8	6.0	5.8
20	2	2	1.8	1.7	1.8
Sensitivity Ratio 3:1 **					
20	8	3	3.3	3.5	3.9
20	9	6	6.6	6.4	6.4
20	10	9	9.2	9.0	9.1
20	11	12	12.2	12.0	11.8
20	12	15	15.0	14.8	14.6
20	13	18	18.0	18.0	18.0
20	12	15	14.4	14.0	14.2
20	11	12	11.0	11.2	10.8
20	10	9	8.8	8.2	8.0
20	9	6	5.7	5.8	5.4
20	8	3	3.0	2.5	3.0

\* Dial setting 76.5 psi

\*\* Dial setting 76.5 psi

Table 7-7. Functional Test Data Obtained After 4000 Cycles

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
Sensitivity Ratio 1:1 *					
20	2	2	2.2	2.4	2.5
20	6	6	6.8	6.2	6.4
20	10	10	10.6	10.1	10.4
20	14	14	14.4	13.9	14.0
20	18	18	18.5	18.0	18.3
20	14	14	14.0	13.6	13.8
20	10	10	10.0	10.0	9.8
20	6	6	6.2	6.0	6.0
20	2	2	2.0	2.0	2.0
Sensitivity Ratio 3:1 **					
20	8	3	3.4	3.0	3.4
20	9	6	6.0	6.0	6.2
20	10	9	9.0	8.8	9.0
20	11	12	12.1	11.8	11.8
20	12	15	15.0	14.0	14.0
20	13	18	18.2	17.7	17.6
20	12	15	14.4	13.5	13.4
20	11	12	11.6	10.4	10.8
20	10	9	8.8	7.8	8.0
20	9	6	6.0	5.4	5.6
20	8	3	3.4	2.8	2.8

\* Dial setting 77.0 psi

\*\* Dial setting 77.0 psi

Table 7-8. Functional Test Data Obtained After 5000 Cycles

Supply Pressure (psig)	Sensing Pressure (psig)	Control Pressure (psig)			
		Required	Run 1	Run 2	Run 3
* Sensitivity Ratio 1:1					
20	2	2	2.2	2.3	2.3
20	6	6	6.8	6.5	6.4
20	10	10	10.8	10.4	10.4
20	14	14	14.6	14.1	14.0
20	18	18	18.0	17.7	18.1
20	14	14	13.6	13.6	13.6
20	10	10	9.7	9.8	9.8
20	6	6	5.7	5.6	5.9
20	2	2	1.8	2.0	1.8
** Sensitivity Ratio 3:1					
20	8	3	3.0	3.4	3.2
20	9	6	6.0	6.0	6.0
20	10	9	8.8	8.8	9.2
20	11	12	11.4	11.6	12.1
20	12	15	14.6	14.4	14.6
20	13	18	18.0	17.8	18.0
20	12	15	13.8	13.8	14.2
20	11	12	11.0	10.5	11.4
20	10	9	8.2	8.6	8.6
20	9	6	5.4	5.0	6.0
20	8	3	2.6	2.4	3.2

\* Dial setting 75.5 psi

\*\* Dial setting 80.0 psi

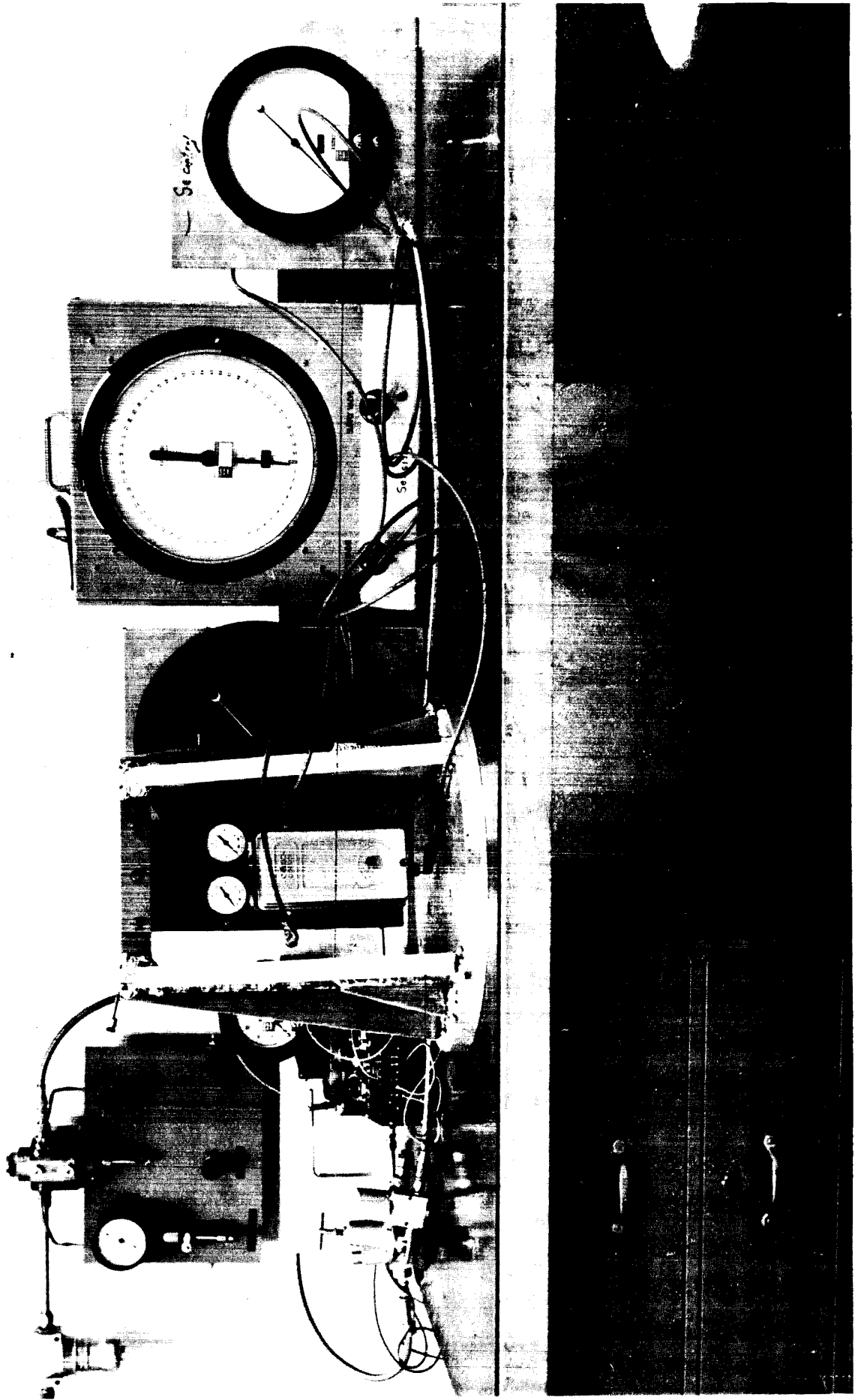


Figure 7-1. Operational Cycle Test Setup

## SECTION VIII

### BURST TEST

#### 8.1 TEST REQUIREMENTS

- 8.1.1 The sensing, supply, and control ports shall be hydrostatically pressurized to 80 psig for 5 minutes to determine structural integrity.
- 8.1.2 Prior to the burst test, the two pressure gages on the specimen shall be removed.
- 8.1.3 The specimen shall be inspected for distortion and damages.

#### 8.2 TEST PROCEDURE

- 8.2.1 The specimen was installed in the test setup as shown in figures 8-1 and 8-2 with equipment listed in table 8-1.
- 8.2.2 The two pressure gages were removed from the test specimen and the lines plugged. The specimen leak port was also plugged.
- 8.2.3 Flex Hoses 9, 10, and 11 were connected to the specimen supply, control, and sensing ports, respectively.
- 8.2.4 Hand valve 5 was closed.
- 8.2.5 Hand pump 1 was operated until a pressure of 100 psig was indicated on gage 2.
- 8.2.6 Relief valve 3 was adjusted to limit pressure to 80 psig.
- 8.2.7 Hand valve 6 was opened and system pressure was bled to zero psig; then hand valve 6 was closed.
- 8.2.8 Hand valve 5 was opened. Pump 1 was used to maintain system pressure at approximately 10 psig while all lines were bled to eliminate air from the system and the specimen.
- 8.2.9 Pump 1 was operated until 80 psig, as indicated by gage 4, was applied to the specimen.
- 8.2.10 The pressure of 80 psig was held for 5 minutes and then system pressure was bled by slowly cracking hand valve 6.
- 8.2.11 The specimen was checked for any damage.

#### 8.3 TEST RESULTS

8.3.1 Attempts to pressurize the specimen hydrostatically resulted in leakage past the lower diaphragm assembly. A pneumatic proof pressure test was then performed and similar leakage occurred at low pressure.

8.3.2 A second attempt to hydrostatically pressurize the sensing, supply, and control ports to 80 psig was successful after removal of the following parts from the specimen:

1. Lower Diaphragm Assembly
2. Lower Diaphragm Plate
3. Upper Diaphragm Reinforcement
4. Lower Diaphragm Spring
5. Spacer

8.3.3 The resulting burst pressure test was a test of the structural casting and not the entire internal mechanism.

#### 8.4 TEST DATA

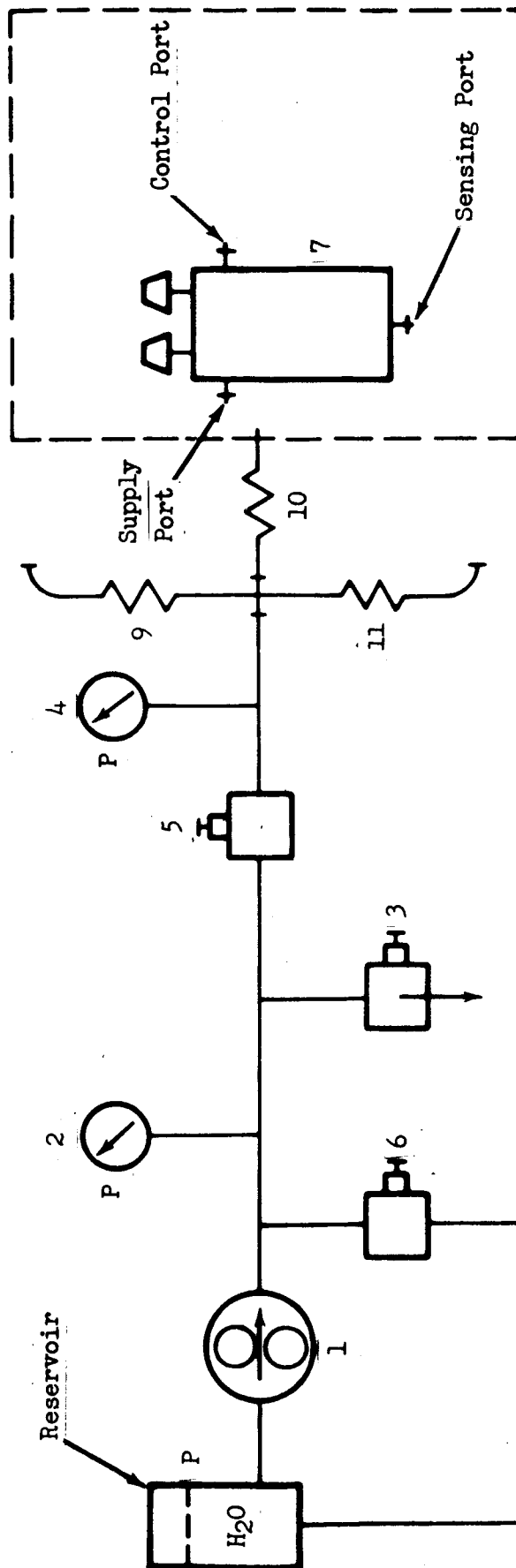
Test data are contained in table 8-2.

Table 8-1. Burst Test Equipment List

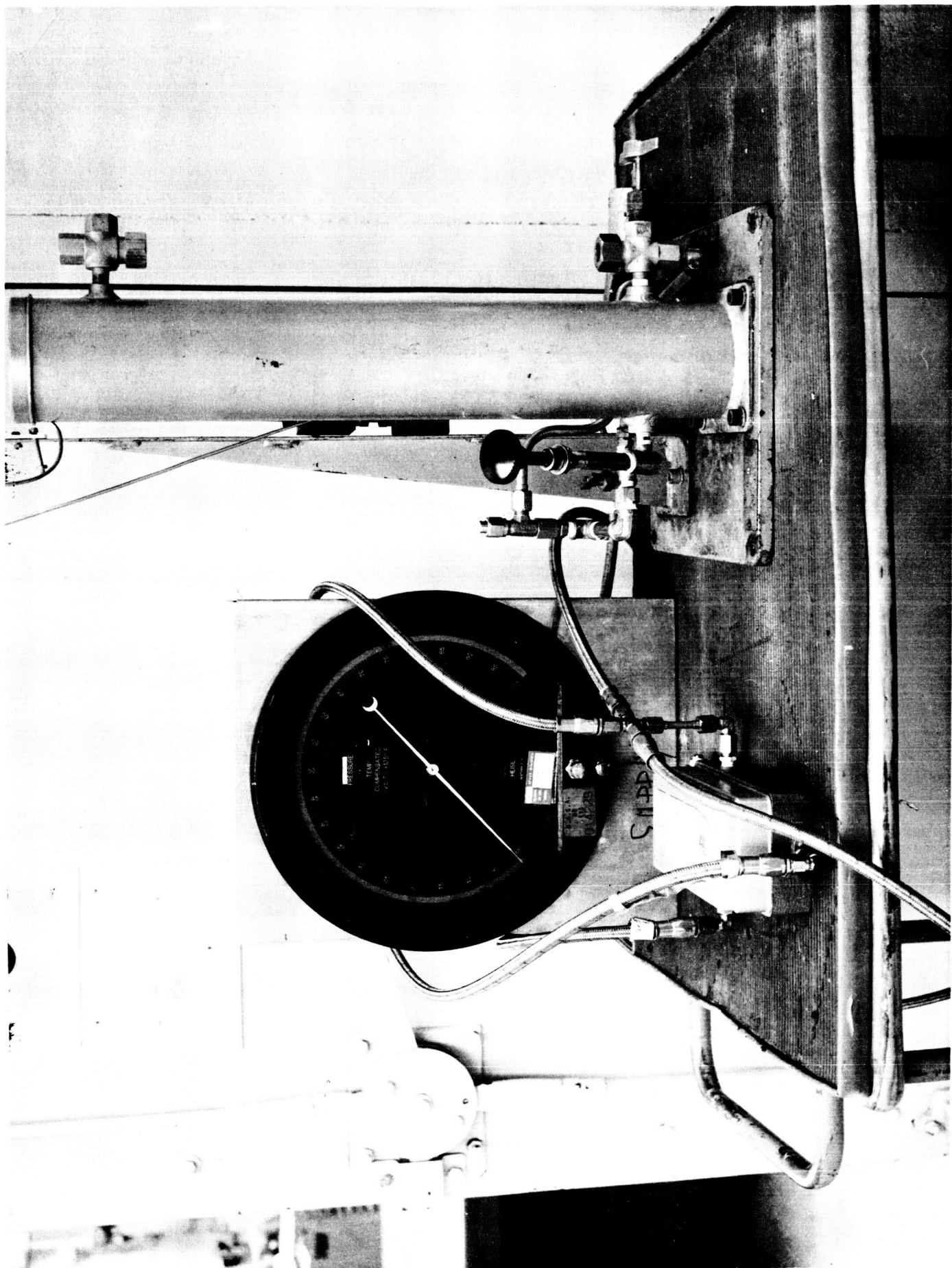
Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Hand Pump	Pressure Products Industries	NA	K750	0 to 1000-psig
2	Pressure Gage	Heise	NA	NASA 108-1003 -B	0 to 150-psig +0.25% FS accuracy Calibration date 9/8/66
3	Relief Valve	Anderson Greenwood	81B66-6	23665	0 to 100-psig range
4	Pressure Gage	Heise	NA	NASA 014,229	0 to 100-psig +0.25% FS accuracy Calibration date 11/3/66
5	Hand Valve	Robbins	SSKA250 -4T	NA	1/4-inch
6	Hand Valve	Robbins	SSKA250 -4T	NA	1/4-inch
7	Test Specimen	Johnson Service Company	R-970	NA	Pressure reg- ulator 0 to 20-psig
8	H <sub>2</sub> O Reservoir	CCSD	NA	NA	
9	Flex Hose	Resistoflex	NA	NA	1/4-inch
10	Flex Hose	Resistoflex	NA	NA	1/4-inch
11	Flex Hose	Resistoflex	NA	NA	1/4-inch

Table 8-2. Burst Test Data

Applied Burst Pressure (psig)	Time (min.)	Results	Remarks
80	5	Satisfactory	Test of casting only (see paragraph 8.3)




NOTE:  
All tubing 1/4 inch.  
See table 8-1 for item identification.




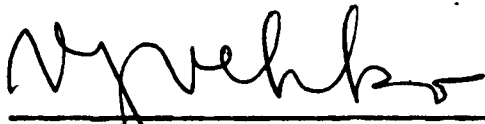
APPROVAL  
TEST REPORT  
FOR  
PRESSURE REGULATOR  
Johnson Service Company Part Number R-970  
NASA Drawing Number 75M04406 PPR-5  
and  
75M04406 PPR-6

SUBMITTED BY:

  
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R. W. Claunch  
Program Supervisor

  
\_\_\_\_\_  
V. J. Venko  
Director, Engineering Department

DATE: 6/1/67

# PUBLICATION CHANGE

THE FOLLOWING CHANGES APPLY TO PUBLICATION: Technical Report

TITLE: TEST REPORT FOR PRESSURE REGULATOR

Johnson Service Company Part Number R-970, NASA Drawing Numbers 75M04406 and 75M04406 PPR-6

NUMBER: TR-RE-CCSD-1069 DATE: Feb. 17, 1967 BRANCH: Reliability Engineering

-3

1. Page 4-6, Table 4-4:

Delete Sensing Pressure "20.0" and substitute "2.0."

Delete Required Control Pressure "20.0" and substitute "18.0."

2. Page 4-6, Table 4-5:

Delete Sensing Pressure "18.0" and substitute "8.0."

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PAGE 1 OF 1

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